Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

DEPARTMENT OF AGRICULTURE.
SPECIAL REPORT—No. 40.

THE CONDITION AND NEEDS

OF

SPRING WHEAT CULTURE

IN

THE NORTHWEST

By Hon. C. C. ANDREWS,
OF MINNESOTA.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1882.

CONDITIONS AND NEEDS

OF

SPRING WHEAT CULTURE IN THE NORTHWEST.

COMMERCIAL IMPORTANCE OF THE CULTURE OF HARD SPRING WHEAT.

It is well understood by those who keep informed in regard to agriculture in the United States that the production of spring wheat in the Northwestern States has become a very important occupation. What has given it its chief importance is the invention and use of the new and so-called "Patent" process of manufacturing wheat flour which has come into operation during the past ten years. Before the introduction of this new system of milling, the flour that was made from spring wheat was usually of a dark and inferior grade, and valued considerably below that which was made from winter wheat.

The merit of "patent" flour made from the hard spring wheat of the Northwest had become fully established and recognized in commercial circles some time before 1876. In the Centennial Exhibition of that year it received the highest testimonials after the most impartial and skillful tests. The judges of "animal and vegetable products and the machinery for their production" at that exhibition, appointed from various countries, in their report, as drawn up by Mr. Walter S. Greene, of Milford, Wis., say:

> The finest flours made in the United States are now made from spring wheat. These fine grades are known as "Patents," and are made from the middlings of hard spring wheat. * * * The flour made from purified middlings of hard spring wheat was very fine, and the State of Minnesota had a large exhibit. This flour is both white and strong, possessing a large quantity of gluten. As a bread-making flour we consider it par excellence, making the largest number of pounds of fine bread from a fixed number of pounds of flour, retaining its moisture a long time, and being very sweet and wholesome.

In consequence of this remarkable invention, hard spring wheat commands in the market six cents more per bushel than any other sort. There has been an extraordinary increase in the number and capacity of flour mills; till now, in the city of Minneapolis, Minn., where the vast water power of the Saint Anthony Falls of the Mississippi is made available, are some of the best and largest flour mills in the world. Similar mills are found in nearly all of the prominent towns of the Northwest. Those at Minneapolis last year consumed 14,000,000 bushels of wheat, and this year nearly 20,000,000 bushels, drawn from Minnesota, Dakota, Iowa, Wisconsin, and Nebraska. Their total capacity, however, is 25,000 barrels of flour a day, or nearly 8,000,000 barrels a year. The flour of these and other mills is shipped to various cities in the Union and to England, Scotland, and other foreign countries. Several million dollars of capital have been put into flour mills within the past few years. Large "elevators," with steam apparatus, for the storage of wheat, have been built in all the leading railroad towns, and are to be seen along the railroads far out on the frontier. An increased impulse has been given to wheat-growing, and it has been stimulated by railroad companies which held immense tracts under government grants of ten to twenty years ago, and which could be sold in large bodies. The smooth, level, fertile prairie affords such facilities for cultivation that it is not now unusual to find tracts of several hundred acres wholly devoted to wheat-growing. There are several instances in Minnesota and Dakota where a capital of $25,000 and upwards has been invested in wheat lands and wheat culture.

The few facts above stated tend to show that the production of spring wheat in the Northwest is a subject of commercial and national importance. Unfortunately there have been, during a few years past, some serious drawbacks to the industry. The grasshopper raid began in 1873, and did more or less damage the next four seasons. During some recent seasons, and notably in 1878, the wheat crop was seriously injured by the hot weather immediately following rain. But there appears to be a general opinion that success in wheat-raising is becoming very much endangered by the too-prevalent practice of growing the crop many years continuously on the same field, and thereby causing the deterioration and exhaustion of the wheat-producing qualities of the soil.

I was much impressed by the frank statement of Abraham Lincoln, made about 1859, at an agricultural fair in Wisconsin, that, according to the best information he could obtain, the average yield of wheat in Illinois was only eight bushels per acre. Also, by a statement of Professor Johnston, of Scotland, that wheat-growing in the United States is constantly receding westward, and that the farmers of this country, with their present system, will become less and less able to export wheat. Professor Johnston was an uncommonly skillful chemist and agriculturist, and made a thorough agricultural tour of the United States from 1848 to 1850. He was a man of such attainments that he was employed to deliver a course of scientific lectures before the Lowell Institute of Boston, and at Albany. He was also employed to make a report on the agriculture of New Brunswick. His observations were published in two volumes, entitled "Notes on North America," and it is in that work that his views of American farming are given. He expressed the opinion that "the wheat-exporting regions are gradually shifting their locality and retiring inland and towards the west"; and that "the Americans, with their present knowledge and methods, will year by year become less able to export wheat." He found that even the celebrated wheat region of the State of New York—the Genesee Valley—as a whole, was gradually approaching an exhausted condition.

OBJECT AND SCOPE OF THIS REPORT.

Being of the opinion that a similar improvident practice of farming was threatening the wheat culture of the Northwest, I thought it would be beneficial to the cause of agriculture if an inquiry were made into the methods now in use among farmers in this part of the country, with a view to ascertain and report the actual situation in respect to wheat-growing, and any remedy which farmers of the greatest skill could recommend to at least prevent a decline in this valuable industry. The Commissioner of Agriculture having approved my plan, I began my investigations in the month of July last, and since then have visited Freeborn and Mower counties in Southern Minnesota, the county of Goodhue (perhaps the leading wheat-growing county in the United States), the valley of the Red River of the North; also, Northwestern Iowa, and Southern and Central Wisconsin as far as Madison. I have consulted the most experienced and skillful wheat-growers in all of these and some other localities, and carefully noted their statements; and I purpose in what follows to present the views gathered from them, and especially the plan of farming which they regard as best adapted to the successful production of spring wheat.

The opinion was universal among those consulted that the yield of wheat has generally been growing perceptibly less for the past ten years. In a few localities the decline is attributed to chinch-bugs; in others it is claimed that a change has occurred in the climate, that the summers are warmer than they were twenty years ago, and that the higher temperature has proved injurious to the crop. The prevailing sentiment, however, was that much of the trouble was owing to a continued growing of wheat on the same land year after year without doing anything to replenish the soil.

EXPERIENCE AND OPINIONS OF WHEAT-GROWERS IN DIFFERENT COUNTIES.

In presenting the experience and opinions of different farmers, I will begin with Freeborn County, situated in the southern tier of counties in Minnesota, and the fourth county west from the Mississippi River. It has twenty full townships, is traversed by railroads in two or more directions, has a prairie surface moderately undulating, and, like a majority of the agricultural counties of the State, is pleasantly diversified by timber-skirted lakes. The soil is a dark-colored loam with clay subsoil. A. C. Wedge, M. D., of this county, whose residence has been at Albert Lea the last twenty-five years or more, and who has a finely situated farm on the park-like land two miles west of the city, a gentleman of much skill and intelligence, attributes the decline in the yield of wheat in Southern Minnesota to several causes. He says:

> Naturally the first is the exhaustion of the soil by continued growing of wheat on the same land. Another cause seems to have been the extreme heat which has prevailed during recent seasons when the wheat was about in the milk. It has seemed to me that the dryness of the soil is one cause of the failure, and I think the wet season we have just had, causing the ground to be well soaked a depth of two feet will prove beneficial to next year's crop. Seeding the ground down with timothy and clover, deep plowing, and a rotation of crops are the best means I know of to promote an increase in the yield of wheat.

Mr. A. M. Johnson, of the town of Manchester, Freeborn County, has raised wheat in Minnesota eighteen years. The soil of his farm is similar to that of the greater part of the county (which is considered a very good farming county), namely, a dark loam a little sandy, with self-drawing clay subsoil of light color, with blue clay at a depth of ten feet. Mr. Johnson says:

> There are two elements operating against us in raising wheat: first, atmospheric, and, second, the exhaustion of the soil by constant cropping. We are all going out of wheat-raising as fast as we can. There is general despondency in regard to wheat-growing. Recently we have been threatened with the chinch-bug. The yield of wheat in my neighborhood this year is 10 to 12 bushels to the acre. To increase the production we must manure the soil and practice a rotation of crops. * * * When I began to raise wheat my yield was never less than 20 bushels to the acre.

Mr. John Godley, who has a finely situated and well-managed farm of 240 acres a mile and a half south of Albert Lea, though acknowledging the general decline in the yield of wheat, has himself practiced rotation from the start, which is perhaps due to his being a native of England. He says:

> My land has been cultivated from seven to ten years. For the last three or four years I have not raised less than 13 bushels of wheat per acre, but before that the yield was 22 bushels per acre. It was Scotch Fife; the seed was purchased here and I have raised the same sort right along. * * * I cannot say that I have a system of rotation, though I have tried rotation as far as I could. Have never raised wheat continuously on the same land for more than three years. After three years of wheat have changed to corn or oats. * * * I do not know of anything that troubles wheat about here but hot weather, which causes it to ripen prematurely, and hot weather immediately following wet weather. There were a few chinch-bugs about here last year, but none this year. There are, however, many this season on sandy land about three miles from here.

Mr. Morin, of Albert Lea, has 2,300 acres in wheat, Scotch Fife, this year, in different localities. He lets the land to neighboring farmers in quantities of from 50 to 100 acres; he furnishing the seed, about which he takes great pains, and frequently visits the farms in person. He states:

> The land is mostly new. Some of it has been in crop eight years, and a part of it only three years. It has never produced less than 12 bushels to the acre; some of it will yield about 18 bushels to the acre. I shall seed down 400 acres in timothy and clover to rest it. * * * Many farmers get discouraged and neglect a part of the work, but they are beginning to take more pains in cleaning seed.

Mr. H. N. Ostrander, who has a farm of 160 acres, 4 miles north of Albert Lea, and who has made wheat-growing a specialty for many years, says:

> My wheat crop of 1878 was almost a failure on account of the blight. The seed which I sowed that year was from the best crop of 1877. The crop of 1879 was better than that of 1878, but not good, being only about 13 bushels to the acre. In 1880 I had 17 bushels to the acre, of Scotch Fife. * * * More attention should be given to mixed farming.

MOWER COUNTY adjoins Freeborn on the east, and is of the same extent with similar fertility. Its west side is drained by the Cedar River, and it is crossed in different directions by two or three railroads.

Mr. Ellis, who lives near Austin, has a farm of 800 acres, and has been farming in Minnesota since 1857. He is a prominent stock-raiser, is engaged in mixed farming, and was the first farmer in that part of the State to raise red clover. He stated that his wheat crop was good in 1877, but had been poor ever since. He, with other farmers, was rather discouraged in raising wheat, and had about decided to quit it; thinks the summers are getting warmer. This season he has raised the "Lost Nation" and a Russian variety. His crop had a very heavy straw, and he thought the yield would not exceed 15 bushels to the acre.

Mr. Nicholas Burns, of Austin, rents 300 acres of naturally good prairie land near the railway station of Ramsey, and owns a considerable tract in Murray County. He is a native of Ireland, where he learned and practiced agriculture, and has had many years of experience in farming in the United States. He says:

> The great defect in farming with us has been the continued growing of wheat for many successive years on the same land. Until I took this farm it had been cropped twenty-two years, and the yield had become reduced to 5 bushels of wheat per acre. The next year, 1877, the season was very favorable for wheat, and I raised 22 bushels per acre. That fall I covered 60 acres with farm-yard manure; planted with corn the next season, and had a large crop of corn. The following year sowed the same field with wheat, and averaged 15 to 16 bushels to the acre, of a good quality of wheat, although the season was a poor one.

HOUSTON COUNTY is in the same tier as the two last-mentioned counties, but lies on the Mississippi River, and thus constitutes the southeastern corner of Minnesota. Its southern line extends some 25 miles below La Crosse. The surface of this county is much broken for some miles back from the river, the highest plateaus being 200 or 300 feet above the river, and covered in some places with oak openings, in others with thicker forest. Its landscape is thus attractive, and its soil is generally quite fertile. One of its striking features is the Root River, which drains the north half of the county from west to east, flowing through a rich and well wooded valley, and on whose banks are many thriving vineyards. The county is also crossed by two railroads. Mr. H. F. Kohlmier, a native of Germany, residing at Wilmington, close to the Iowa line, has been farming in Houston County since 1857, and says:

> The yield of wheat has been growing less for some years back, and was only about 5 bushels per acre the present season, mostly "Lost Nation." On newly broken land

the yield is much less than it used to be, from which it would seem that the decrease is owing largely to climatic causes. The light yield on old land must also be a good deal in consequence of the exhaustion of the wheat-producing qualities in the soil. The best way to restore the yield is to raise different crops, and especially clover. In 1856 spring wheat was successfully grown where I lived in Northern Illinois; but its culture there has since failed. The farmers in Houston County, for a few years back, have been raising a good deal of corn and working into a rotation of crops. Corn does very well on the old wheat land.

According to the United States census, the average yield of wheat per acre in these three counties in the year 1879 was as follows: Freeborn County, 11.02 bushels; in Mower County, 9.20 bushels; in Houston County, 10.52 bushels.

NOBLES COUNTY lies in the same tier with the three that have been mentioned, but near the western boundary of the State. Of the southern tier of counties in Minnesota it is the eighth from the Mississippi River. It has a level prairie surface, a few large and handsome lakes, many natural meadows, and a soil of good average fertility. Mr. Barr, who commenced wheat-growing in the southern part of the county in 1873, says:

> My first four crops in succession were destroyed by grasshoppers. Then, in 1877, I had a very good crop. Last year my crop cost me over $1 a bushel, and I sold it at 75 cents a bushel. A farmer in my vicinity this year had 100 acres in wheat, none of which was worth cutting. The soil is good, but what most injures wheat is the occurrence of wet and hot weather at the same time. * * * The failure in wheat makes it necessary that farmers should turn their attention more to stock. They must, of course, go slow, as they came here thinking it a wheat country.

According to the census, the average yield of wheat in this county in 1879, was only 2.71 bushels per acre. The census returns are, however, corroborated by the commissioner of statistics of Minnesota, who says: "The report of Nobles County for 1879, shows that county to have harvested just about enough wheat to get back the seed."

RED WOOD COUNTY is on the south side of the Upper Minnesota Valley, and is classed with the southwestern counties of the State, though in the third tier from the southern line.

Mr. Valentine, of Saint Paul, has been engaged in wheat raising in that country the past six or seven years. He says:

> Owing to grasshoppers, blight, &c., have had poor success up to this year; have had to dig for my information on wheat growing—to gain it by experience—as I found very few who could give me the desired information. * * * Where I sowed the blue-stem wheat early this year, which, however, was no earlier than May 6, I shall get a good crop, say 20 bushels per acre, when my neighbors will get only 5 bushels per acre. * * * Last year I applied salt to 125 acres, this year to 1,600 acres. * * * I think this application of salt will increase the yield 100 per cent. Last year the increase was 40 per cent. * * * There is more money in raising corn and hogs in this State than in raising wheat.

The average yield of wheat in Red Wood County, in 1879, was 6.1 bushels per acre.

Proceeding now 60 miles south of the southern boundary of Minnesota, and crossing the two northwestern tiers of counties in Iowa, we come to PLYMOUTH COUNTY, Iowa, which is on the western boundary of that State.

It is a county of more than usual beauty of surface, being liberally watered by clear meadow-bordered streams, and having undulating prairies, studded with hard-wood groves. An important impulse has recently been given to agriculture in that county by the settlement in it of a well-equipped English colony under the leadership of the Close brothers. The seat of their operations is at Le Mars, and my visit to that place was in the middle of September.

Mr. Bettsworth, one of the first settlers in that neighborhood, has a farm of 280 acres, a mile from Le Mars, and he is regarded there as a very successful farmer. The soil of his farm consists of sandy loam with gravelly sub-soil, and he has worked it for the last sixteen years. He says:

> I formerly farmed in Northern Illinois, where "Canada Club," a soft kind of spring wheat, was cultivated a number of years, but finally failed, as Scotch Fife has done here. I have raised Scotch Fife every year for the last fifteen years, except this year. For the past few years it has not done well, and this year I tried "Sea Island," and got 20 bushels to the acre.

Mr. Bettsworth raises excellent corn, and keeps his field remarkably free from weeds. He says:

> I have succeeded better with wheat after corn, and have sown the wheat on the ground without plowing.

Mr. O. A. Moore, who has farmed twelve years in this county, says:

> Hard wheat did well here until three years ago. In 1878 the blight struck it, and the next year the grasshoppers. The yield this year is not over 4 to 6 bushels. The decline in the yield of hard wheat led me to try a soft variety called the "Sea Island," and brought to this county from Cherokee County. It yielded here last year from 22 to 28 bushels per acre. They grind it at the mill here (Le Mars) and make good flour. This year's crop is not threshed.

Mr. P. Gallagher has been engaged in farming near Le Mars during the last thirteen years. His farm consists of 160 acres, situated on high rolling prairie, the soil of which is sandy loam. He says:

> In 1879 I raised "Scotch Fife" and "Sea Island" wheat on two 20-acre tracts lying side by side. The ground had been summer fallowed and the weeds plowed under. The seed was put in early. The hard wheat was injured by rust, and of the whole 20 acres I got but 100 bushels, a yield of only 5 bushels per acre. The adjoining 20 acres of "Sea Island" yielded 25 bushels to the acre. In 1880 I tried both hard and soft wheat again, the hard yielding 6 or 7 bushels per acre and the soft 20 bushels. This year I had hard wheat on land where I had corn last year, and did not cut any. I think my soft wheat this year will average 12 bushels to the acre. Have sown wheat after corn, the latter being manured, and the ground plowed in the fall.

Mr. Peter Branch, of Le Mars, a native of Belgium, has had over twenty years' experience in raising spring wheat in the Northwest, the first years being in Stearns County. He now has a well-selected farm, a few miles from Le Mars, which he manages with superior skill. He says:

> In 1877 I had 15 bushels of wheat (Scotch Fife—the only sort he raises)—per acre on old ground. In 1878 I had 20 bushels per acre on new ground, and a like yield the

next year on the same ground. This year my yield is ten bushels per acre. The cause of so small a yield this year was that I seeded too late, which was in consequence of the season being backward. A crop of 10 bushels to the acre, however, will pay good expenses. * * * Generally farmers, in their fall plowing, do not plow deep enough, and as a consequence in dry weather wheat will suffer in a week.

The United States census shows that the average yield of wheat in this county, in 1879, was but 1.80 bushels per acre. Were the skill and pains applied that are exercised by Mr. Branch, the yield would probably be equal to his. Corn, hog, and stock raising are leading and profitable branches of farming in the county, as well as in the surrounding parts of the State, and further notice will be given of them in connection with the system of renting land as practiced by the Close brothers.

BUTLER COUNTY is in the same tier with Plymouth County, but about 200 miles further east. Mr. P. J. Eberrold, of Butler, has raised spring wheat for twenty-five out of twenty-seven years that he has resided there, and thinks the decline in the yield is owing mostly to adverse seasons. He says:

There are, to my mind, many causes that help to make wheat culture no longer profitable.

DANE COUNTY, Wisconsin, is in about the same latitude as Plymouth and Butler Counties, Iowa, being due west from Milwaukee. It occupies the center of Southern Wisconsin, and is in the second tier of counties north of Illinois. The State capital, Madison, is situated in the center of the county, between two large and beautiful lakes, whose moderately sloping shores are surrounded by many valuable farms, the fences of which, here and there, are stone walls. The following are parts of statements furnished me during my visit there the latter part of September:

Mr. Russell, of Madison, secretary of the Dane County Agricultural Society, describes the soil of that region as that of burr-oak openings and prairie, the openings being composed of clay, and the prairie of dark loam. It is cream-colored. He states:

The soil is now exhausted of wheat-supplying qualities. Wheat has not averaged over 7 bushels per acre for the last ten years. Twenty-five years ago one could break new land and be sure of getting 25 to 30 bushels per acre. A similiar experience has been had in Illinois. * * * For the last ten years farmers have lost money trying to raise spring wheat. They do not like to give it up. They take pride in raising some wheat. Nevertheless, men who used to have their 50 or 100 acres now have 2 or 3 acres—just enough so it shall not be said that they do not raise any. Ten years ago we had 160,000 to 200,000 acres in wheat in this county. It had been constantly declining, till now only about 70,000 acres are in wheat, including all sorts. The leading variety is the "Lost Nation." Only a little hard wheat is raised. Mere wheat growing is a very shiftless sort of farming, as it employs the farmer only a portion of the time. It was not till within the past seven years or so that any system of rotation of crops has been practiced. Within that time farmers have begun to seed down clover. The most economical way of recuperating soil is by putting it in clover. I think it is the exhaustion of the soil by continued growing of wheat, rather than atmospheric causes, which has led to the failure of wheat. Climatic changes have had no material effect. Three years ago there was a good yield of winter wheat, but for the past two years it has been a failure from being spring killed. The chinch-bugs seem to be a consequence of the poverty of the soil, as lice attack a poor, half-fed calf. They migrate; and when once they get into the soil they cannot be got rid of except by putting it into clover.

Mr. Robbins is an intelligent miller, formerly from Watertown, Mass. He is the proprietor of the only flour mill at Madison, which has a capacity of 100 barrels of flour a day, and personally attends to the purchase of wheat for grinding, and to the management of the mill. He has been there the past sixteen years, and expresses the opinion that the growing of hard wheat in that region has "played out." To supply his mill he pays the farmers more for their wheat than they could get from the shippers, and yet, although the most of the wheat grown in the vicinity is brought to his mill, he finds it difficult from these sources to get enough to keep the mill running. He says:

Hard spring wheat is now raised only as an exceptional crop. The bulk of the wheat is the "Prussian," or as frequently called, "Lost Nation," and has been grown here during the past six years. If any crop is got at all it is from that. The "Red Astrakan," the "White Michigan," and "Rio Grande," all soft varieties, are also raised to some extent. We get along with the soft wheat with the rollers, as we do not make the "patent" flour. * * * I attribute the decline in the production of wheat to the hot weather, and not to the soil, because it is found that new land will not yield any better than the old. The poorest land (lightest soil) yields the best wheat in quality, but not the most. The best soil in the vicinity is in the oak openings; though not so deep as the prairie soil, it will last fully as long.

Mr. H. J. Hill, formerly of the Genesee Valley, New York State, has followed agriculture in this county thirty-five years. His farm is 4 miles from Madison, and has a soil of rich loam. He says:

Spring wheat is no longer a paying crop in this latitude. The "Scotch Fife" did well till about ten years ago, when the chinch-bugs came. For the past six or seven years the most of the spring wheat which has been raised hereabouts has consisted of the "Prussian" ("Lost Nation"), and the "Odessa." The decline in the yield has, in my opinion, been caused in great part by continual cropping of the same land with wheat. My best wheat crop was in 1860 (I think it was in 1860), and I think it was owing to having been sown in the month of March. Last year I put a barrel and a half of salt on 6 acres seeded with "Lost Nation" wheat, and got 18 bushels per acre. I lately tried spring wheat on new land, and the chinch-bugs got into it and spoiled it so that I did not cut the crop. Have used clover for several years, and I think it some protection against the chinch-bugs. Although my land is especially adapted to grain, I think it essential to practice mixed farming of grain-growing and stock-raising.

Mr. Joseph Heim, a native of Bavaria, has a farm of 120 acres, 6 miles from Madison, bordering on Fourth Lake, on which he has raised spring wheat successfully the past thirty-two years. The land is rolling, the highest portion being 150 feet above the lake, and was, when he took it, covered with openings of large burr-oaks. The soil is of mixed clay and sand, and the farm has been mainly cultivated by the labor of himself and his brother. His statement in regard to wheat was as follows:

I have given my wheat fields a rest every four or five years by raising corn and manuring the land. There has been some decline, however, in the yield. About eighteen years ago I got 20 bushels to the acre, but of late years only about 12 to 15 bushels. Have raised "Rio Grande" wheat for twenty-five years, and am not acquainted with the "Scotch Fife." My "Rio Grande" tests 59 or 60 pounds, and sometimes 62 pounds per bushel. I get as high a price for my wheat as any one else. I would not expect to keep up profitable wheat growing if I did not change occasionally from wheat to other crops.

Another German farmer living more distant from Madison, and who has had thirty years' experience raising wheat and other grain in Dane County, informed me that ten years ago the farmers in his vicinity, finding that wheat growing was getting "played out," began to try a change of crops in order to give the wheat land a rest. For some years back they have been raising different sorts of spring wheat, among them the "Lost Nation." Some farmers, he stated, get 6, some 8, and some 12 bushels to the acre.

Prof. W. A. Henry, in charge of the experimental farm of the State Agricultural College, says:

> This year we have raised at the experimental farm, "Rio Grande," "Lost Nation," and other varieties of spring wheat, but no "Scotch Fife." The yield was 12 bushels per acre. I considered the principal cause of the decrease in the yield of wheat to be atmospheric.

Prof. W. W. Daniels, of the Agricultural College, who was absent in Europe at the time of my visit, is reported in the Proceedings of the State Agricultural Society of Wisconsin, 1880, page 379, as saying:

> Some years ago large yields of wheat were obtained in this State. Why not now? Because the State has been put to wheat so long. There are certain minute qualities which are necessary to produce wheat—nitrogen, potash, and phosphoric acid. As these exist in the soil only in limited quantities, a course of crops diminishes them, though the soil be good when the cropping commenced. In England experiments for thirty years without fertilizers have failed, with fertilizers have been kept up. To continue the same crop takes continually the same ingredients from the soil. The supply by freezing and thawing and fertilization may be kept up.

He recommends Wisconsin farmers "to raise winter wheat, and thinks that whether the wheat is hard or 'soft' is a point we need not consider at all."

Mr. George E. Bryant, secretary of the State Agricultural Society of Wisconsin, and a leading practical farmer, who was also absent at the time of my visit, is reported in the same volume as saying:

> To-day, in our State, south of the Wisconsin River, wheat cannot be called a leading crop. * * * Its continued production has done much to impoverish the soil, for where twenty-five years ago 30 bushels per acre was a usual yield the same lands to-day yield less than 10. * * * What the lands of Wisconsin want is better cultivation and more fertilization. How shall we get it? By selling more on the hoof and in the fleece, and less in the half-bushel; by raising grass and making hay.

According to the census, the average yield of wheat in Dane County, in 1879, was 9.83 bushels per acre. The average for the whole State was 12.82 bushels per acre. The total production of wheat in the State, in 1879, was 24,884,698 bushels, being 721,636 bushels less than the production in 1869.

Mr. Henry B. Clarke, a prominent farmer of Whitewater, Walworth

County, Wis., a county bordering on Illinois, states, under date of November 21, 1881:

I have not raised a bushel of spring wheat in ten years. Stopped raising it because coarse grain crops paid better.

GOODHUE COUNTY, Minnesota, is one of the most interesting wheat-growing localities in the State of Minnesota, being known as the "banner" wheat-growing county of the State. Its yield in 1879 was 2,415,891 bushels, which was exceeded by only three other counties in the United States, namely: Madison County, Illinois, and Colusa and San Joaquin Counties, California. It borders partly on Lake Pepin, in the Mississippi River, and lies midway between the forty-fourth and forty-fifth parallels of latitude, being well drained by the Cannon and Zumbro Rivers. The geologist, Mr. Owen, in the report of his survey made in 1849, describes the soil of the locality as follows:

The land best adapted for wheat and most small grains, and in which the proportion of earthy, saline, and organic matter is distributed in the best proportion to impart fertility and durability, is the soil based on the calcareous and magnesio-calcareous rocks, and which particularly characterizes the country bordering on the Mississippi and its tributaries, between the forty-first and forty-fifth degrees of latitude, with an average width of 20 to 30 miles west of the Mississippi.

Mr. Perkins, of Redwing, one of the many skillful farmers in this county, stated, August 16:

The principal drawback to wheat in this part of the State is the chinch-bug, though we have never had them bad in this county until this year. Again, the wheat qualities of the soil have been taken out of it to a great extent. I have been farming for the past twenty-five years, and for the past fifteen years have usually put down from 20 to 30 acres in clover and timothy every year. My soil consists of black loam, with clay subsoil, and my practice has been and is to sow the wheat three years on the same field. As often as every five years I want the ground in grass. The smallest yield of wheat I have ever had was 14 bushels to the acre, and until three years ago I never had less than 20 bushels to the acre; and have raised as high as 35 bushels to the acre.

Mr. W. C. Rice has lived in Minnesota since 1856, and farmed in Goodhue and Olmstead Counties. He has a farm of 160 acres in Goodhue County, worked wholly by hired labor, which last year paid him $890. He says:

Farmers in Goodhue County will have to turn their attention to something besides wheat—say stock and grass. The principal drawback to wheat growing in this county is the chinch-bug. I also attribute the failure this season partly to the fact that the seed wheat remained in stack all winter. I have found by experiment that such wheat when sown will not produce a crop. The remedy against the impairment of the soil in this county is the use of red clover raised as a grass crop. In June, 1880, a farmer of this county plowed under 100 acres of red clover that was 3 feet high, and raised a remarkably good crop of wheat on the land this year. The land had been cropped fifteen to twenty years. * * * We shall raise more wheat to the acre hereafter, but not so many acres. * * * The reputation of Minnesota flour depends upon raising hard wheat—"Scotch Fife"—which is the best variety we now have.

Mr. Frank Davis, of Redwing, says:

I have been farming in Minnesota twelve years, following the exhausting system of raising wheat, which has prevailed in Minnesota. It is my purpose to change my system and raise a variety of crops, recuperating my land by stock. Our soil is that of a high rolling prairie and clay loam. We plow as early as possible after harvest, turning the furrows from 5 to 7 inches deep. We use the "Fife" wheat, taking great pains to secure the best seed. I have three times, in twelve years, gone to Canada to renew my seed. * * * I have not yet thrashed, but have an idea my crop this year will yield about 17 bushels to the acre.

Mr. Davis' valuable observations as to an economical rotation of crops will be found in another place in this report.

The average yield of wheat in Goodhue County, in 1879, was 12.13 bushels per acre.

DODGE COUNTY, Minnesota, adjoins the last-mentioned county on the south.

Mr. C. S. Kneeland, of Mantonville, in this county, a farmer and miller, came to Rock County, Wisconsin, in 1843, and has since been acquainted with wheat growing in that State; also in Minnesota since 1864. He says:

> The failure in the wheat crop the past few years is owing partly to the hot weather and partly to bad farming. * * * We have had no No. 1 wheat in Dodge County for the past three or four years. Good farmers do not raise any No. 3 wheat; they raise No. 2, and generally of the hard variety. * * * Undoubtedly a rotation of crops and good systematic farming will do much to restore the yield of wheat.

The average yield in this county, in 1879, was 9.78 bushels per acre.

STEELE COUNTY, Minnesota, lies immediately west of the last-named county, is quite level, but considerably elevated, with reference to the rest of the State, and covered heavily by drift.

Mr. A. Colquhoun, of Blooming Prairie, Steele County, formerly of Pictou, Nova Scotia, has a farm of 640 acres, of which 150 acres are under cultivation, 120 in pasture, and the balance in grass or wood. The soil is a dark, sandy loam, resting on hard, gray clay about 9 feet in depth, and under that blue clay. He states:

> I have been farming continuosly since 1866, and during the first years used to raise 25 bushels of wheat per acre, the highest yield being 29 bushels per acre. I raise only "Scotch Fife." My yield in 1877 was 25 bushels per acre. Since 1877 the average yield has been about 10 bushels to the acre. Some have raised as low as 4 bushels, and some as high as 18 bushels. There have been no bugs to hurt, and I think the main cause of the decline has been too much rain in July, in conjunction with hot weather, while the wheat is in the milk. Wheat does not do well on low land. It produces best on high land, and on land which has had a change of crops.

The average yield in this county, in 1879, was 11.02 bushels per acre.

DAKOTA COUNTY adjoins Goodhue County on the north. Its most northerly limits extend to Saint Paul, and it is regarded as a very good wheat-producing country.

Mr. T. T. Smith, one of the leading farmers of this county, has a finely situated farm near Mendota, which formerly belonged to General Sibley. A part of it has been cultivated many years. The soil is not uniform, but varies from 1 to 2 feet of brownish loam, with a subsoil of clay and stones. Granite bowlders are to be seen occasionally along the roadside. He has practiced a rotation of crops, and his average yield has been from 14 to 28 bushels of wheat per acre. There have been only two years when his yield was less than 20 bushels per acre. In an old field which had been under cultivation twenty years the yield was only 10 bushels per acre. He says:

> Twenty years ago the "Canada Club" was in use. The second year I used it its yield was eight bushels to the acre. I discontinued it on account of smut. I then used the "Odessa," a soft wheat, about three years. It yielded better than the "Canada Club," but had a weak straw, and lodged and rusted badly. I then got the "Scotch Fife," which I have used ever since. My wheat fields have generally been in Indian corn or potatoes before sowing with wheat. * * * The wheat crop is generally overestimated. A trouble with wheat in this vicinity is its being badly mixed; a number of varieties are found in the same field. * * * The principal danger to the wheat crop in this vicinity is storms; dry hot weather also gives it a premature ripeness. The last ten days of the crop are the most critical. The continuous growing of wheat for several years on the same land cannot be considered profitable farming.

The average yield in Dakota County, in 1879, was 10.68 bushels per acre.

WASHINGTON COUNTY is immediately north of Dakota County, on the eastern boundary of the State, and is also considered a good wheat producing county.

It was at Cottage Grove, in this county, that Mr. Dalrymple began his extensive system of wheat culture.

Dr. T. T. Mann, of Saint Paul, who was engaged in growing wheat at Cottage Grove, from 1861 to 1871, thinks the decline in the yield of wheat is to be attributed to the exhaustion of silica in the soil, and that the most practicable way to recuperate the soil is to seed it with grass and practice a rotation of crops. His farm at Cottage Grove had the common loam soil of average fertility, and he found that after three years cultivation in wheat, the yield diminished to from 12 to 15 bushels per acre. During one of the first years his yield was 39 bushels per acre. He took pains in the selection of seed, frequently changing it, though adhering to the same variety, "Scotch Fife." Dr. Mann says:

> The true theory is this: the soil should rest every three or four years with grass.

The average yield in this county, for 1879, was 12.58 bushels per acre.

A valuable statement by Mr. Peterson, of Woodbury, will be found in another part of this report.

RAMSEY COUNTY adjoins Washington County on the west, and contains the capital of the State. It has some remarkably good farms cultivated by experienced and skillful farmers. One of these, Mr. W. B. Quinn, formerly of Kentucky, whose farm lies 3 miles from Saint Paul, in the township of Rose, says:

> I have raised wheat in Ramsey County the last twenty-seven years. Have noticed a decline in the yield of wheat in this State during the last three or four years, even on newly-broken land, which I attribute to the hot weather at the time of ripening. There has also been a decline in the yield on old land, which can be attributed to the recurrence of wheat on the same ground for several years. The means I would recommend to increase the yield on the old land is to sow it with clover and adopt a system of rotation.

> My soil is on burr-oak openings, consisting of black. sandy loam and light yellow clay subsoil, mixed with sand and resting on gravel at a depth of 5 or 6 feet. This farm has been under cultivation twelve years. The only kind of wheat I have raised on it for a crop is "Scotch Fife," pure. * * * I have never raised less than 17 bushels to the acre. For the first six consecutive years I averaged 33 bushels per acre. * * * My system of rotation is, corn or potatoes, then wheat followed by grass or corn.

The average yield of wheat in Ramsey County in 1879 was 15.79 bushels per acre.

Carver County.—Mr. A. W. Tiffany, of Norwood, Carver County, a county lying on the north side of the Minnesota River, having a rolling surface and originally mostly covered by the "big woods," with a clay loam soil adapted to wheat, has grown wheat there during the last twenty years. He says:

> When I began the yield was 25 bushels per acre. A noticeable decrease commenced about six years ago and has continued since, with the exception of 1877. The average yield now is not over 12 bushels per acre. "Scotch Fife" is the variety raised. I attribute the decline partly to the exhaustion of the lime in the soil and partly to the weather, which of late years has been unfavorable. I have practiced a rotation of crops all the time, my rotation being, after wheat, oats, then corn, then wheat. Have also seeded down some grass. I see that we have got to raise stock and corn.

According to the census, the average yield of wheat in Carver County in 1879 was 17.64 bushels per acre.

Wright County adjoins Carver County on the north, and has a similar soil, the cultivated lands being mostly clearings from the "big woods."

Mr. T. C. Porter, of Clearwater, Wright County, has grown wheat in that and in Sherburne County the past thirty years, but chiefly in the former county. He says:

> We have generally got a good crop on new land the first three or four years. The yield has at times gone down from 25 bushels per acre to 8 or 9 bushels. I attribute the decline in the yield more to drought than to heat in our section of country. A majority of farmers there practice a rotation of crops, and have done so the last six or seven years. Hence the average yield in Wright County has now been right along about 12 to 14 bushels of wheat per acre. The usual rotation is corn, then wheat. They are getting into grass and clover. * * * My rotation is wheat, oats, and corn. * * * I have been farming on that farm twenty-five years, and get about as good crops as when I began. Had about 15 bushels per acre of hard wheat this year.

The average yield of wheat in Wright County in 1879 was 15.80 bushels per acre.

Meeker County lies immediately west of Wright County, its surface consisting partly of the hard-wood timber of the "big woods," and partly of prairie. It has a number of timber-fringed lakes, and the Crow River flows through the northern portion of it. Its soil is of fair average quality.

Mr. O. M. Linnell, of Grove City, Meeker County, a native of Sweden, who has raised wheat more or less for twenty-five years in Minnesota, and for the past six years in Meeker County, states:

> I have observed a decline in the yield of wheat; especially the last six or seven years there has been very much change. It has occurred as much on land that was formerly

covered with timber as on prairie soil. I attribute the decline almost wholly to the climate, because new land that has never been worked does not yield as it did in former years. Of course where land is worn year after year with wheat it cannot be expected to yield as well as if a rotation of crops had been practiced.

My rotation has been wheat, oats, corn, and then wheat. The proper way is to seed to pasture, but we have not got to that in Meeker County.

My yield last year was 22 bushels per acre of No. 2 hard ("Scotch Fife") wheat. This year on 200 acres I raised 2,002 bushels of the same sort, averaging 13 bushels to the acre. I do not think the average yield in Meeker County would go over 10 to 12 bushels per acre. On some farms it would be 5 bushels, on others 19 bushels per acre. * * * Many of the farms in Meeker County have been continuously cropped with wheat for the past twenty years. To restore the yield I would decidedly recommend a rotation of crops. Clover has been tried around Litchfield with middling success, but not where I am. I attach great importance to plowing early in the autumn. In many cases it is worth 5 bushels an acre more.

The average yield of wheat in Meeker County in 1879 was 12.09 bushels per acre.

STEARNS COUNTY, adjoining the two last mentioned counties on the north, contains thirty-six townships, and is an important agricultural county. The "big woods" extend over the middle and eastern portion, while the western part consists of rather high rolling prairie. The north fork of Crow River drains the southwestern townships and the Sauk River, the valley of which twenty years ago was much noticed for its beauty and fertility, winds prettily through the whole length of the county. About half of the farmers in the county are natives of Germany. Mr. John Cooper, whose farm is on Pearl Lake, 12 miles southwest of Saint Cloud, has had twenty years' experience in wheat-growing fifteen of which have been in Minnesota. The soil of his farm is a sandy loam, with a clay subsoil, being a mixture of timber, brush, and prairie land. His yield of hard wheat last year was 25 bushels per acre, and this year 14 bushels per acre, the decreased average arising from 10 acres being covered with water and wholly unproductive. Mr. Cooper says:

There appears to have been a decline in the yield of wheat in the southern part of the State in late years, which is considered attributable to the weather; but up in my part of the State I think that on farms which have been systematically cultivated wheat yields as well as it formerly did. Our good farmers in Stearns County last year got an average yield of 20 bushels per acre. This year the same farmers raise 13 or 14 bushels per acre.

The farm of Messrs. Coates and Freeman, on the east side of the Mississippi River, about half a mile from the river, near the south line of Benton County, this year produced 25 bushels of "Scotch Fife" per acre on new land, and 17 or 18 bushels per acre on old land. Where there has been careless farming, or where land has been run to wheat continuously for many years, there is, of course, a decrease in the yield.

Among some farmers there is a slackness in regard to the time when certain work should be done. Then, again, good land has been so cheap that farmers have felt that they would not suffer much damage by letting their lands get worn out. They could get new in place of it. They have not considered the land worth enough to keep up its quality by a proper rotation and cultivation.

To maintain good crops good farming must be practiced, and a systematic rotation, say wheat, oats, and corn, and when there is not a sufficiency of natural meadows it would be desirable to have a part of the farm in timothy and clover.

The average yield of wheat in Stearns County in 1879 was 14.34 bushels per acre.

POPE COUNTY is immediately west of Stearns, and its surface is principally a high rolling prairie, with the dark loam soil resting on clay or gravel that is common to the greater part of the State. It has a number of large and fine lakes, the borders of which in some places are heavily wooded, and in the timber the soil is a deep and rich mold. A large proportion of the farmers in this county are natives of Norway.

Mr. Ole Peterson, of Gilchrist, a native of Norway, and formerly receiver of the United States land office at Saint Cloud, has been actively engaged in wheat culture in Pope County the past sixteen years, and has several hundred acres under cultivation. His views are as follows:

> In regard to the successful production of wheat, I think the farmers will have to cultivate the soil better and raise more corn. I find if I put corn on the land, cultivate it, and keep all the weeds out, I will the next year have a good crop of wheat, and if that does not keep up the land I would advise seeding it down to clover one or two years and plowing the clover under the second year. The land will then be just as good as new, and will produce 20 bushels of wheat to the acre.
>
> The greatest fault with farming in Minnesota is, that the farmers always sow wheat. I would advise to sow wheat two or three years, then oats, then wheat and clover, and the next year plow the clover under. If this is kept up the land will continue to produce wheat.

The average yield of wheat in this county in 1879 was 11.85 bushels per acre.

ISANTI COUNTY is 100 miles east of the county last mentioned, and in the same latitude. Its northern and eastern sides are covered with hard-wood timber, and the soil of the rest of the county is a sandy loam, and rather light. The county is principally settled by natives of Sweden. Mr. T. H. Caine, of Spencer Brook, states:

> The average yield of wheat in the county is 12 bushels per acre; the kind raised is "White Fife," hard. There has been I think no perceptible falling off in the yield, as the farmers generally have raised considerable corn and stock, and occasionally varied their crops. The soil appears to stand the dry weather very well, and two or three good crops of corn can be raised successively without manure.

The average yield of wheat in this county in 1879 was 14 bushels per acre.

MORRISON COUNTY is situated on both sides of the Mississippi in the tier of counties north of that containing the three last mentioned. Some townships in the eastern part of the county have a deep and rich loam soil, while those nearer the river have a more sandy soil. Canadian French and Germans comprise a large part of the population, the former having settled at Belle Prairie twenty-six years ago, where they have since been farming.

Mr. C. B. Buckman, of the town of Buckman, Morrison County, has been engaged in wheat growing there the past eight or nine years. He has 1,100 acres of brush and prairie land under cultivation, the soil of which is a deep, black loam, with clay subsoil; he has raised only

"Scotch Fife," and the yield has never been less than 20 bushels per acre until this year, when it was about 15 or 16 bushels. He says:

I have practiced some rotation because I consider it essential to do so to keep up the yield. The cheapest and most effectual rotation is to seed the land with grass and clover. Farmers generally are getting to feel that it is necessary to adopt a rotation of crops. The "Lost Nation" has been tried by some in my vicinity, but without success.

The average yield of wheat in Morrison County in 1879 was 17.25 bushels per acre.

OTTERTAIL COUNTY is a very large county of fifty-four townships, on the line of the Northern Pacific Railroad. It is situated in the "Park region" of Minnesota, and is largely settled by Scandinavians. The surface is diversified with prairie, lake, and timber, and the soil is generally fertile. Mr. D. Burbank, of Pelican Lake, says:

I have been farming but seven or eight years in the northwest, during the first four of which my crops were very much devastated by locusts. My land is rolling prairie and brush, and the soil sandy. Have not got any rotation of crops fairly established yet, except that I seeded, two or three years ago, some of my oldest ground with timothy and clover. The grass has done as well as I could have expected.

Farmers have but just begun to raise timothy and clover in this vicinity. * * * On account of the scarcity of labor I think the farmers about here will have to raise more stock. * * * I have this year raised about 250 bushels of wheat on 15 acres of land (16.66 bushels per acre), and I have put into my barn 30 tons of hay. Though wheat brings a good price, I consider the hay the most valuable crop. * * * If the manufacturers of flour want the farmers to raise any particular variety of wheat, they must offer such a price for it as will make it as profitable for the farmers to raise that variety as any other.

CLAY COUNTY lies immediately west of Ottertail County, with the Red River of the North for its western boundary; it is crossed from east to west by the Northern Pacific, and from north to south by the Saint Paul, Minneapolis and Manitoba Railroads, and is drained by the Buffalo River, which flows through beautiful undulations. It is regarded as having as good wheat land as any county in Minnesota.

Mr. C. B. Kittredge, of Glyndon, has raised wheat in this county four years. His soil is a sandy loam, from 12 to 15 inches deep, with clay subsoil. Writing November 8, he states:

From observation, I should say that the wheat crop was as large on old fields this year as in any previous year. Some of our land is better for wheat the second and third years than the first. In some cases weeds, wild buckwheat, &c., have diminished the crop. This year I had no wheat, only oats and barley (about 85 acres). Last year a part of my 40 acres of wheat was very poor on account of mixed seed; the balance yielded 18 bushels on breaking.

As to the best system of farming for a profitable cultivation of wheat he answers:

Land well plowed in the fall, crop sowed early in the spring, harvested as soon as ready, and allowed to stand in shock as short a time as possible before stacking. I should have no objection to growing wheat several years in succession upon the same land, but think the sooner we introduce stock raising in connection with it the more profitable will be wheat raising to the average farmer.

The average yield of wheat in Clay County 1879 was 15.21 bushels per acre.

MARSHALL COUNTY is situated midway in the celebrated valley of the Red River of the North; for a breadth of 10 or 12 miles nearest the Red River the surface is flat, with a black loam soil resting on a lightish-yellow clay. At a greater distance from the river the surface becomes somewhat undulating. As in other parts of the valley, the streams are more or less wooded, thus breaking the monotony of the scenery, and flow in channels from 10 to 20 feet below the general surface.

Mr. Alfred Diamond, of Tamarac (Stephen's Station), has a finely cultivated farm near that place, and bordering on the Tamarac River, on which he raises good crops of wheat. He states, however, emphatically, after several years' experience in farming, that "raising wheat alone does not pay." In a written statement, since kindly furnished me, he says:

> Although wheat raising this year has been very profitable in this section, I have not changed my views in regard to raising wheat alone.

DAKOTA.

The information which has recently been published in leading magazines and journals in this country, as well as in the London Times, in regard to the extraordinary wheat farms in Dakota, and the adaptability of its soil for wheat culture, renders it unnecessary that much should be said of that Territory here. The extensive and enterprising operations of Mr. Dalrymple and others have not only attracted universal attention to the fertility of the soil of Dakota, but have contributed much to make wheat farming (what it really should be) an intellectual and fashionable occupation, and in this way have advanced agricultural science. Nevertheless, it seems to be the settled conviction of all concerned that wheat growing as a sole and only crop cannot, even in Dakota, prove remunerative for a long series of years, and that it is advisable to divide the mammoth plantations into small farms to be cultivated with mixed crops.

Mr. Andrew McHench, of Fargo, Cass County, Dakota, who has grown wheat there during eight years, states that—

> The decrease in the yield is slight and mostly caused by foul seed, such as buckwheat. * * * Wheat has been grown in the valley (of the Red River) for fifteen years, rotating with oats. Oats will improve the soil for wheat.

Mr. McHench resides in one of the most fertile sections of Dakota, but is of the opinion that mixed farming, or a succession of crops, is essential to maintain fertility.

A GENERAL DECREASE IN THE YIELD OF WHEAT.

After reading the statements of so many intelligent and experienced farmers, no one can doubt that there has been a general decrease in the yield of hard wheat in the Northwest during the past few years.

The fact is also established by reliable statistics. The census of the United States for 1870 gave the returns of agriculture for the year 1869. The early summer of that year was very cool in the Northwest, and highly favorable to spring wheat; but the crop was considerably damaged before it was fully gathered, by heavy and long-continued rains. In Iowa the wheat crop proved, on account of the wet weather, a "partial failure."

The census of 1870 did not give the acreage of any crop; in which regard the census of 1880 is an improvement; but the total yield of wheat in Iowa in 1869 is shown to have been 29,435,592 bushels.

The best estimate of the average yield per acre that I am aware of is that furnished by the secretary of the State Agricultural Society of Iowa. He finds the average yield of eight representative counties to be 13¼ bushels per acre, and assumes that to be the average for the State. The census of 1880 shows that the total production of wheat in Iowa in 1879, which was a fair year, was 31,154,205 bushels. The acreage is also given, showing that the average yield of wheat per acre in Iowa in 1879 was only 10.21 bushels per acre. Mr. Pusey, commissioner of statistics of Minnesota, in remarking on the wheat crop in 1869 in that State, says:

> The year 1869 will long be remembered as the cool season. In no previous year since the settlement of the State, except, possibly, the corresponding year of the preceding decade, 1859, did the mean temperature of the spring, summer, and autumn months rule so low. The advance of spring, though slow, was regular; while the rains during the growing season, though light, were sufficient for the needs of vegetation, and their recurrence was timely and favorable in an unusual degree. The peculiarity of the early season was the cloudiness, and the entire absence of that alternation of warm showers and hot suns which mark our springs and early summer, and which, acting upon a black, friable, and receptive soil, forces the vegetation of our State with amazing rapidity. * * * Thus matters stood at the beginning of the harvest of 1869. Although less showy in luxuriant amplitude of stalk, there was, unquestionably, a greater yield of plump, bright grain awaiting the reaper than has characterized any harvest since 1865.
>
> The harvest had fairly begun when there occurred a series of incessant and violent rains which, for their flooding and destructive character, will ever render memorable the harvest of that year. Nothing approaching them in rapidity and duration has ever been known in the agricultural history of the State. The result was, of course, a prolonged and expensive harvest, and great losses both in the quantity and quality of the grain.

The official returns in his report show that the number of acres in wheat that year was 1,006,007. His returns also show that the average yield per acre in the State was 17.55 bushels. The census for the United States, however, shows that the total production of wheat in Minnesota in 1869, was 18,866,073 bushels, which, taking the average as stated in the report of the commissioner of statistics, shows an average yield per acre of 18.75 bushels. The census of 1880 shows the total production of wheat in Minnesota in 1879 (considered a fair year) was 34,601,030 bushels, and that the average yield per acre was 11.33 bushels, showing an average decrease in yield per acre, in 10 years, of 7.42 bushels.

The total production of wheat in Wisconsin in 1869, according to the United States census, was 25,606,334 bushels. The secretary of the State Agricultural Society characterizes the crop of that year as a "pretty fair" one, and estimates the average yield per acre at 15 bushels.

According to the census the average yield of wheat per acre in that State in 1879 was 12.82 bushels, showing a decrease of 2.18 bushels per acre.

CENSUS OF 1880 SHOWS THE RATIO OF INCREASE OF WHEAT CROP LESS THAN THAT OF OTHER CROPS.

The census of 1880, which, in respect to agriculture, is the fullest and best ever made in this country, shows still more striking facts, namely, that the ratio of increase in the wheat crop in the States of Iowa, Minnesota, and Wisconsin is exceedingly low as compared to other crops. Of course in a young State like Minnesota, where millions of acres have in the past ten years been entered under the homestead law, and where vast fertile areas like the Red River Valley have been opened to settlement by the construction of railroads, an extraordinary increase in agricultural development would be expected as compared with the census of 1870; but even in Minnesota, where wheat growing is regarded as a specialty, the increase of wheat production was relatively less than the increase of production in some other crops. The production of wheat in this State in 1869, as we have seen, was 18,866,073 bushels, and in 1879, 34,601,030 bushels, being an increase of 15,734,957 bushels; or in round numbers an increase of 83 per. cent.

The production of oats in 1869, was 10,678,261 bushels, and in 1879, 23,382,158 bushels, being an increase of 12,703,887 bushels, or 118 per cent.

The production of barley in 1869 was 1,032,024 bushels, and in 1879, 2,972,965 bushels, being an increase of 1,940,941 bushels, or 188 per cent.

The production of Indian corn in 1869 was 4,743,117 bushels, and in 1879, 14,831,741 bushels, being an increase of 10,088,124 bushels, or 212 per cent.

In Iowa the production of similar crops in 1869 and 1879 was as follows: Wheat, 1869, 29,435,592 bushels, and in 1879, 31,154,205 bushels, being an increase of 1,718,613 bushels, or only 5 per cent. Oats, 1869, 21,005,142 bushels, and in 1879, 50,610,591 bushels, being an increase of 29,605,449 bushels, or 140 per cent. Barley, 1869, 1,960,779 bushels, and in 1879, 4,022,588 bushels, being an increase of 2,061,809 bushels, or 105 per cent. Indian corn, 1869, 68,935,065 bushels, and in 1879, 275,024,247 bushels, being an increase of 206,089,180 bushels, or 300 per cent.

In Wisconsin the production of the same crops in 1869 and 1879 were as follows: Wheat, 1869, 25,606,334 bushels, and 1879, 24,884,698 bushels, being a *decrease* of 721,636 bushels, or 3 per cent. Oats, 1869, 20,180,016 bushels, and in 1879, 32,905,320 bushels, being an increase of 12,725,304 bushels, or 63 per cent. Barley, 1869, 1,645,019 bushels, and in 1879, 5,043,118 bushels, being an increase of 3,398,099 bushels, or 206 per cent. Indian corn, 1869, 15,033,998 bushels, and in 1879, 34,230,579 bushels, being an increase of 19,196,581 bushels, or 127 per cent.

These facts will better strike the eye in the subjoined tables.

Cereals.	Yield, 1869.	Yield, 1879.	Increase.	Per cent.
MINNESOTA.				
	Bushels.	*Bushels.*	*Bushels.*	
Wheat	18,866,073	34,601,030	15,734,957	83
Oats	10,678,261	23,382,158	12,703,887	118
Barley	1,032,024	2,972,965	1,940,941	188
Indian corn	4,743,117	14,831,741	10,088,624	212
IOWA.				
Wheat	29,435,592	31,154,205	1,718,613	5
Oats	21,005,142	50,610,591	29,605,449	140
Barley	1,960,779	4,022,588	2,061,809	105
Indian corn	68,935,065	275,024,247	206,089,182	300
WISCONSIN.				
Wheat	25,606,334	24,884,698	*721,636	3
Oats	20,180,016	32,905,320	12,725,304	63
Barley	1,645,019	5,043,118	3,398,099	206
Indian corn	15,033,998	34,230,579	19,196,581	127

* Decrease.

THE BEST SYSTEM OF SPRING-WHEAT CULTURE.

Whatever may be the opinion of people in regard to a decline in the yield of spring wheat in the Northwestern States, no one will be likely to deny that there is considerable room for improvement in the methods practiced by a majority of farmers in its culture. What, then, is the best plan to follow in order to raise wheat profitably, and at the same time preserve if not improve the quality of the soil? I will endeavor to answer the question by giving in a concise and simple form a statement based on the fresh testimony of those farmers heretofore quoted whose experience, skill, and judgment entitle them to be considered good authority. My wish is to furnish a summary or manual which will prove of value to the less experienced farmers, and especially to those who are about to engage in wheat-growing for the first time.

And first as to soil. Spring wheat requires a dry and fertile soil, with good exposure. Rich clays and heavy loams are the best, but the situation must not be low and wet.

> There are sometimes peculiarities of season [says Morton] which render the cultivation of wheat quite as profitable, and even more so, on light soils than on heavy ones; still, on an average of years, the firm, deep soil retains the preponderance. There is,

however, another truth of far higher importance in a practical point of view than that involved in an inquiry into the natural capabilities of various soils for growing wheat, and this is the fact that with a few exceptions nearly every kind of land, whether composed of clay, loam, chalk, gravel, or sand, will produce paying crops of wheat if drained, cleaned, and brought up to a certain pitch of fertility by high farming—a term which comprehends three principal operations, namely, relieving the soil from all superfluous water by drainage, ridding it of weeds, and filling it with manure, either in a solid or liquid state.

The wheat-producing quality of the soil of the Genesee Valley has long been famous. In 1833 Daniel Webster visited the farm of Mr. E. Le Roy, on the Genesee River, near Avon, and thus described the soil of the upland:

> This seems a peculiar soil. It is full of small stones, and the ground covered with a growth of oaks, of no great size. To the eye it does not seem to be extraordinary land, but its fertility is very great, especially for wheat and clover. When plowed, little pebbles, stones as they would seem, are turned up in great plenty, but these crumble or dissolve by exposure to the air, and seem to be marl, or a mixture of lime and clay, or some such thing which I do not exactly know about. This land grows better by cultivation. It will yield two crops of wheat, then one of clover, then one year pasturage, and then wheat again, all without manure. The only rotation seems to be from wheat to pasturage.

Mr. Johnston, of Scotland, who visited the Genesee Valley in 1848, describes the soil as "a rich drift clay."

In the strong red clay bordering Lake Superior, in the black yet bluish-tinged rich loam of the valley of the Red River of the North, in the light-colored clays of Central Wisconsin and Minnesota, also in the dark mold resting on clay or gravel which characterizes most of the prairie as well as timber land in the Northwest, one finds a soil which experience has shown to be naturally adapted to wheat. A soil well cultivated derives great nutriment from the atmosphere. Morton, writing in 1854, says:

> Nor does it now seem doubted that the atmosphere contains a sufficiency of every organic ingredient which is required by the wheat plant. And here again is displayed that harmony which runs through and accompanies each process of the plan. For when the clay or loamy soil has thus been deepened and pulverized, and so far enriched, it is fitted for its other important office; it has become a retentive absorbent of the riches of the atmosphere, which drop unrepelled into its bosom, and are there reserved, either for the use of the growing plant, or to accumulate for the succeeding crop.

Dr. Madden, in his prize essay on the question, "What has science done for agriculture?" lays down among others these two propositions, which a majority of American farmers no doubt will assent to:

1. Cultivated land when properly taken care of becomes gradually richer and richer, notwithstanding the increased quantity of produce annually removed from it.
2. If the same plant be cultivated for several years successively upon the same spot, the soil much more rapidly decreases in fertility than when a variety is kept up.

An American writer says:

> Soils consist of the more or less comminuted fragments of rocks, mixed with certain products of their chemical decomposition, and with some organic matter—the *debris*

of vegetation that has grown upon them. The composition of the soil varies according to the rocks from which it originates. It is rare that large tracts of soil are exclusively derived from the rocks that now underlie them. * * * That part of the soil which is soluble in the water of rain, represents its available plant food.

Breaking.—Farmers agree in the opinion that the "breaking" or first plowing of natural prairie land should be done in the month of June. Certainly it should not be done later than, say, the 20th of July. The object of doing it as early as in June is to give time for the decomposition or rotting of the dense vegetable fiber or roots of which the sod is composed, while exposed to varied weather during the balance of the summer. The approved practice is to break to a depth of 2½ or 3 inches. The 14 or 16 inch sulky plow, drawn by three good horses, is now generally used in breaking. Three horses are also used with the walking or hand plow. Breaking is also done with the gang sulky plow, which consists of two 12-inch plows, one obliquely behind the other, and drawn by four horses. It thus breaks a width of two feet, and as effectively as any plow. Good horses walk when plowing at the speed of 2 miles an hour; hence, one can calculate the area that can be broken in a day.

The price of breaking common prairie land has been, during the past three or four summers, from $2.25 to $2.50 per acre. In the valley of the Red River of the North, the summer of 1881, the usual price for breaking and back-setting was $4.75 per acre. The amount which can be broken in a day depends much upon the length of the field. As it is not usual nor desirable to break across the ends of a field, the farmer divides his breaking into comparatively narrow strips or lands, so as to save distance and time in going around the ends. Having finished the first strip or "land," he breaks around the second "land," gradually narrowing it, and finishes with the "dead" or center furrow, which affords drainage. The best breaking is that done by farmers themselves for their own use, or that which is done under their personal supervision. Where considerable tracts are broken under contract it is not unusual to do it in a slipshod manner, or to "cut and cover." This latter phrase means to skip a strip of turf the breadth of a furrow and to cover it with the next furrow. Of course, it would not be safe for a contractor to leave too many such strips unturned, but to leave any so is injurious; and if he is not known to be entirely trustworthy it will be best to let him understand beforehand that his work will undergo a thorough inspection.

Sod crops.—It is sometimes the practice, though confined to farmers of very limited means, to plant Indian corn or sow flax on new breaking. In such case the breaking would have to be harrowed before putting in the crop. Corn on new breaking, as a rule, yields but an inferior crop. Where land is intended for wheat it is not considered sound economy to take any crop from it the first summer it is broken.

Back setting.—It is now the practice of nearly all good farmers to replow their breaking in the autumn. They plow in the same direction as the original breaking furrows, going an inch deeper with the plow, and thus turning the breaking furrow back in its original position. Hence the term "back-setting." This process exposes another surface of the soil to the winter weather and facilitates the disintegration as well as decomposition of the turf. Back-setting is done in the autumn succeeding the breaking, and farmers of the best judgment are of the opinion that no part of the farm work pays better.

Harrowing before sowing.—Some farmers do not harrow the ground in the spring before sowing. It is work, however, which had better be done, and just as early as the frost is out of the ground enough to work it. American farmers do not pulverize their wheat land nearly as much as do European farmers. In about every country in Europe one will see the fields which have been prepared for wheat as clean and finely pulverized as garden beds are in this country, and that undoubtedly is one cause why a larger yield per acre is obtained in Europe than in the United States. It is not necessary to wait till the frost is entirely out of the ground, but the harrowing should be commenced as soon as the frost is out enough for the purpose, say a depth of 3 inches. Rather a common fault in this sort of work is the use of a light, cheap, and ineffectual implement. The cultivator tooth harrow does the best work on new land. It has 72 teeth and cuts a breadth of 11 feet. With it a man with one pair of horses could harrow 15 acres in a day, going over the sod once. The effect of the harrow is in proportion to the velocity with which it is driven. Hence a team drawing it should be kept at a brisk gait.

Seed and sowing.—To sow clean seed is one of the vital parts of wheat-growing. The greatest pains should be taken to have the seed thoroughly free from cockle and other seeds of weeds. The fanning-mill with separator attachment will clean wheat from all foul stuff. So important is it to have perfectly clean seed that not a few careful farmers even go to the trouble of picking over their seed wheat by hand the winter before it is to be sown, and they are abundantly paid for their pains. It is owing much to the lack of seasonable care in cleaning the seed that one witnesses such quantities of mustard, wild buckwheat, and other intrusive vegetation in so many wheat fields.

Some of the best farmers select and set apart in their field before harvest those groups or patches which are the most forward, vigorous, and sound, and gather them separately for the purpose of seed.

The practice of soaking the seed in brine or other liquid is not usual, and does not appear to be essential. Where mixed varieties of seed are sown in the same field, they do not ripen at the same time, and on that account turn out badly in the harvest. For this as well as other reasons only one sort should be sown on the same land. As a sole, certainly as a leading variety, there can be no question whatever that a hard wheat, the "Scotch Fife," will prove the most remunerative, especially on new and well cultivated land. Its distinction consists in its superior excellence in gluten, and in being the only kind from which the famous "patent" flour can be manufactured. The most experienced wheat-growers advise getting fresh seed from a new locality, and especially from Canada, every few years. Wheat grown on sandy soil and sown on clay soil, or grown on clay soil and sown on sandy soil, improves by the change. Skillful farmers seem divided in opinion as to whether the seed should be put in the ground with the "broad-caster" seeder or by the drill, but on old, mellow, and well-cultivated land the preference should be given to the drill, as it is sure to cover the seed properly (an inch and a half deep), if the ground is in a proper condition.

The broad-caster, which is now and for fifteen years has been in use, is provided, some with 12 and others with 14 cultivator teeth to follow the seed spouts, but they do not cover all of the seed; hence it is the common practice to have the harrow follow the broad-caster. The broad-caster is drawn by two horses. It measures the area as it moves along; also the seed, whether wheat or oats, which it sows. It costs $60, and will last, with good usage, twenty years. The drill costs $85, and will last as long as the broad-caster. It is equipped with similar measures of land and seed as the broad-caster, and as before stated will cover the seed effectually. It is not necessary to harrow after the drill unless for the purpose of smoothing the ground.

The quantity of seed sown per acre varies from one bushel to a bushel and a half. Many of the best farmers prefer a bushel, or at most a bushel and a peck. There is no point upon which farmers lay more stress than that of getting the wheat into the ground at the earliest moment possible. It then has the better chance to mature before the occurrence of that alternate hot and wet weather, which, in a few hours, may prove fatal to the wheat when in the milk. Sowing is usually done in April.

The observation of Mr. Rice, of Goodhue County, Minnesota, that seed-wheat left in stack over winter will not, when sown, produce a crop, is a caution which deserves attention.

Rolling.—Many of the best farmers roll their ground after the seed is in. The practice cannot be said to be general, but it is recommended and followed by so many who are successful that it may safely be adhered to. It is usually done when the wheat is 3 or 4 inches high; but the ground should not be rolled when wet. Rollers are for the most part home-made, and are then constructed of logs. As implements in the market they are made of cast iron, cost from $60 to $80, and intended for two and four horse teams.

Application of salt.—So many good farmers have, in recent years, obtained such favorable results by the application of salt to old wheat fields that the usage can be well recommended, at least for trial, on old land, in which clay does not predominate. The extent of its use can be judged from the fact that one dealer at Rochester, Olmstead County, Minnesota, in the season of 1881, sold 2,000 tons to be used on wheat land. At Zumbrota, Goodhue County, 150 tons were sold, the price being $7 a ton. It is a refuse salt known as agricultural salt. It is crushed, and of white color. It is applied when the wheat is 5 or 6 inches high; 150 pounds to the acre, and costs at that quantity, 40 cents per acre. A man drives the load of salt through the field, and another man scatters it with both hands over a breadth of 20 to 25 feet. Thirty acres can thus be spread with salt in a day. Salt attracts and holds moisture. In the statements of different farmers, elsewhere given in this paper, it is shown that wheat crops have been much increased by the use of salt as a manure.

From this time on to harvest, a period of nearly two months, it is not customary among northwestern farmers to do any other work in the wheat field. In the Old World it is somewhat different. In Europe one will often see women or other cheap hands at work killing weeds with the spade-shaped hoe in the wheat fields after the wheat is a foot high or more.

Harvesting.—Spring wheat matures inside of ninety days, and is usually harvested in the Northwest in the month of July. In the northern parts of Minnesota and Dakota the harvest occurs in the latter part of July and first part of August. Wheat should be cut just as soon as the kernel has passed from the milky to the doughy state. It has then a golden color in the field. The advice given by Pliny to the farmers of Italy many centuries ago holds perfectly good now. The best rule, he says, "is to cut it before the grain has got hard, when the ear begins to have a reddish brown appearance. Better two days too soon than as many too late, is a good old maxim." A common fault among farmers is to delay harvesting till it is too ripe. If one waits till the field is wholly ripe a portion will become too ripe before it can be cut.

The twine self-binder is now almost universally used in harvesting wheat. It is drawn by three (frequently by four) horses, the driver riding, and will cut 10 acres a day. Two active men following will put the sheaves properly in shock. Twelve sheaves compose one shock. A good way is to stand the sheaves together two by two. Most farmers would cap the shock by placing two sheaves upon it, top down. Mr. James Howard, a good authority in British agriculture, in a letter to the London Times of August 30, 1881, says that capping shocks is in England an "exploded" system. He says:

> The ears which grow or sprout in ordinary shocks are those inside, sheltered from wind, and where heat is generated. Capped shocks, moreover, when once drenched, take far longer to dry.

Stacking.—Where wheat can be handily taken from the field to market, or to a railroad, it is considered safer and better to thrash it from the shock and directly ship it, without putting it in stack. If, however, the market or railroad elevator is too distant for this plan to be carried out, then not a needless hour should be allowed to pass before it is well put in stack. Experienced wheat-growers agree that a day or two is long enough time for wheat in good condition to remain in shock, and on account of the certainty of protracted rains occurring sooner or later in the harvest season, they insist that stacking should not, under the conditions stated, be longer delayed. Leaving wheat in shock too long, and whereby it becomes damaged by rain, also poor stacking, are two of the prominent causes of loss in wheat culture. As to locality of stacks, if the straw is not to be used for fodder, they can be placed on the poorest soil, having proper elevation, within convenient distance of the sheaves. Of course, they would not be placed so as to require too much time in transport of the sheaves. To avoid loss by fire it will not be best to have them all in the same vicinity. If, as is the rule of most good farmers, the wheat straw is used as feed for live stock, then a sensible plan would be to build the stacks in convenient distance from the farm-yard, placing them four in a group—two on one side and two on another side—so that, in thrashing, the machine can stand in the center and be fed from the four stacks without being moved.

How to stack wheat properly is an art in regard to which there is much ignorance and bad practice. "The testimony of thrashers," says Mr. Quinn, of Ramsey County, "is that a great deal of wheat is improperly stacked." A large sum in the aggregate is lost every year by poor stacking. Many farmers do not sufficiently realize, while at work in the calm sunny weather of the harvest field, that protracted rain storms, driven with the force of a gale, are sure to happen in the autumn while the wheat is in stack. In almost every farming community there are men who are skilled in the art of stacking, and the aid of such should be sought by the inexperienced.

Mr. Burns, whose wheat stacks in Mower County were as perfectly shaped as any I have ever seen, favors large stacks. The diameter of a good stack, he says, should be about 18 feet at the bottom and about 24 feet at a point 5 feet from the ground. The diameter of a stack usually would be about 12 feet at the base and 20 feet at the bulge, and containing 50 to 75 bushels of wheat. That would probably be the safest size. Mr. Quinn, a good authority, says:

> In beginning a stack we set the sheaves on end for the base. Keep the center full Below the bulge have the longer straws of the sheaf uppermost. When you get to the bulge reverse and put the sides with long straws down.

Another experienced wheat grower, Mr. E. J. Hodgson, of Saint Paul gives the following practical advice on this subject:

> But unless stacking is done well it might as well, or better, not be done at all There is no excuse at all for poor stacking. It is a very easy thing to make a stack absolutely water proof, and that is what I mean by good stacking. The looks of a stack in this country pass for nothing, yet it is probable that the comely-looking stack as a rule is the best. The one all-important rule in stacking is to keep the center of

your stack as compact and solid as possible. The first sheaves should be put together as closely as it can be done, and from the bottom to the top keep the middle well up and solid. Put a pole 10 or 12 feet in length in the top of your stack to prevent the top blowing off, and always top off with a few forksful of long meadow hay. Be careful not to make your stack too large. A stack built in this way must settle far more on the outside than in the middle. The straws will all point downward, and will never fail to conduct the water from the stack. If the rain should be of such a drenching character as to beat into the stack, the water will soon drain down through the straw to the outside. It is very plain that if the sheaves are horizontal, or nearly so, the water will not drain out. But it will be said: "This is the old story we have heard a thousand times before; we know it all, and have known it from youth." I simply ask in reply: Do you know it well enough to do it every time? Many do not, and therefore make dunghills out of their stacks, and throw away the labor and opportunities of the whole year, and settle the balance with a mortgage on the homestead, which will be so built as never to "take" water, but wonderfully apt to take land.

The proper stacking of wheat enables it to be kept in a sound condition till such time in the autumn as it can be conveniently thrashed. As soon as his wheat is stacked the farmer can turn his attention to the important work of fall plowing. Another benefit from stacking is that it gives the wheat an opportunity to go through the sweat.

Sweating.—In about three days after wheat has been stacked it will begin to manifest evidence of sweating. On putting one's hand into the stack the wheat will then feel damp. The observations of farmers in regard to the sweating of wheat in stack have not been so minute and searching as could be desired; but a majority are agreed that if the wheat has been seasonably cut and the weather is dry the sweating will be completed in the course of three or four weeks from time of stacking. Farmers are unanimous that sweating in the stack is beneficial to the wheat. During that process the berries are fed from the straw; they become plumper and acquire a brighter color than they possess when thrashed from the shock. The wheat looks better and weighs better. Another fact well vouched for is that during the sweating process the kernels so adhere to the husk that it is impracticable for the wheat to be then thrashed. Thrashing should not be undertaken till the sweating is well over and the wheat is dry. Considering that so much is said by northwestern farmers about sweating in the stack, it is singular that no mention is made of any such thing by English writers on wheat-growing. The northwestern wheat-growers also claim that wheat must necessarily go through a sweat in any event, even if thrashed before stacking. They say that if it does not sweat in the stack it will sweat in the bin. It is true undoubtedly that if wheat has not been thoroughly dried or cured before being thrashed that it will heat, sweat, and become spoiled in the bin if not stirred and properly cared for. At the same time wheat seasonably cut and thrashed without stacking can, with proper pains, be dried so that it will not go through any sweating or heating in the bin.

Autumn plowing.—It is customary as soon as the wheat is stacked to commence plowing the field on which it was grown, if it is the purpose to sow it again with the same or other small grain. Plowing is more easily done when the ground is moderately moist or not very dry, yet so important is it that the plowing be done in the early part of the autumn that farmers enjoin carrying on the work even though the ground be dry. The benefits of early fall plowing are that the foul stuff, barn grass and the like, which is then green, gets killed, while that which is ripe and gone to seed will grow up so that the frost will kill it the same season. The furrows also have a longer time for exposure to the atmosphere. It is rather common for autumn plowing to be done with a 12-inch hand plow drawn by a span of horses or yoke of oxen. With a pair of big horses one can use the 14-inch or 16-inch sulky-plow; but it is more economical to use three horses if they are of ordinary size. Large farmers generally in such work use three horses. Probably a majority of farmers do not plow deep enough. Mr. Cooper, a farmer of good judgment, says:

> Ordinarily I would plow 6 or 7 inches deep, and once in about three years a foot deep. Deep plowing admits the moisture to come up, and thus proves beneficial in a dry season. It is also an advantage for corn.

So, also, Mr. Branch says:

> In fall plowing I plow deep. Generally farmers do not, in their stubble plowing, plow deep enough, and in consequence, in dry weather, wheat will suffer in a week.

The roots of the wheat plant will, if permitted, extend into the soil a depth of 2 feet; hence, one can see the utility of deep plowing in heavy soil.

In some seasons plowing can be continued, throughout Minnesota and Dakota, till the middle or latter part of November, and even till into December. Seasons may also happen like that of 1880, when the winter sets in and stops plowing as early as the middle of October. As a rule, one could count on forty-five days for plowing from the close of wheat harvesting till winter. Two and one-half acres of fall plowing would be a fair day's work; and could be readily done with the ordinary walking plow, 2 acres a day. At this rate 90 acres could be plowed by one man in forty-five days. When one remembers, however, the amount of other autumn work which needs to be done on a farm, the importance of commencing to plow early cannot be too strongly enforced.

Thrashing.—Thrashing is now commonly done by the steam thrashing machine, with spark protection, which uses straw—in some cases coal—for fuel. It will thrash from 600 to 900 bushels a day, and costs, say $1,700. Thrashers charge now 4 or 5 cents a bushel for thrashing wheat, according to locality, and 2 cents a bushel for oats. The farmer finds the fuel, and all the manual labor except the fireman, the engineer, and the feeders. The whole work costs the farmer about 9 cents a bushel.

I was informed by Mr. Dinsmore, a competent machinist at Red Wing that farmers are prejudiced by patent rights, which prevent machines, from combining all the best improvements.

Storing.—The wheat should come from the thrashing machine sufficiently clean for market, and yet farmers of good judgment think it pays to afterward put it through the fanning mill. It is filled into sacks from the thrasher, and if an elevator is not sufficiently handy, must be taken to a good granary. Wheat sacks, which are made of cotton and cost from $18 to $22 per hundred, will each hold 2 bushels, or, if entirely filled, a peck more. In hauling to market, 50 bushels will make a load for a two-horse wagon.

Wheat should be stored in a well ventilated granary built firmly on rock or block foundation. To keep out vermin let it rest on stone or other posts with a tin pan in the shape of a milk pan resting inverted on each post, the sills resting on the pans. The floor of the granary should be about the height of a wagon box, so that it will be easy work in loading and unloading. Ordinarily, on a farm of 160 acres, there will be from 80 to 100 acres under cultivation, of which, say 50 acres, will be in wheat. A granary 20 by 30 feet will afford room for the wheat and oats on such a farm, and could be well built of lumber for $200.

Wheat-straw.—Judging from the big heaps of straw, covering considerable surface, as well as the blackened relics of burnt straw heaps, which one habitually sees in wheat fields, the economical use of straw is yet an unsolved problem. Economical farmers prefer to use as much of their straw as they can for fodder. Sound wheat-straw can be fed to advantage with 3 or 4 quarts of bran a day to an animal. Stock can thus be wintered on straw and bran cheaper and better than with hay at $5 a ton. Bran sells generally at from $4 to $10 a ton. It is now (November, 1881,) worth $11 a ton at Minneapolis, being higher this season than usual on account of the injury done to hay by excessive wet weather. Natural meadow hay is now worth $10 to $12 a ton, though in ordinary seasons it would be worth $5 a ton. If straw is to be consumed as feed it should be put into neat stacks at the time of thrashing, and as it comes from the machine. The work would simply require one or two extra men. A little over a ton of wheat-straw will be produced per acre. Near cities farmers sell their straw for stable bedding at $3 to $4 a ton. In some places paper mills pay the same price.

Equipment for a wheat farm.—For a farm of 160 acres, with 100 acres in field cultivation, the following would be a fair and liberal estimate for a new outfit of stock and implements for wheat culture; also, of present prices, say in the State of Minnesota.

Three horses, at $150 each	$450
One pair of oxen	100
One sulky three-horse plow	50
Attachment to same for breaking	15
Two-horse cultivator	30
Three-horse reaper (self binder)	275
Two-horse harrow	15

Fanning mill with cockle attachment	$20
One wagon	75
One sled	35
One drill	85
Three sets of harness	45
Spades, shovels, hoes, forks, hay rack, &c	60
Total	$1,255

I am informed that in the past three or four years the prices of agricultural implements in the Northwest have not risen, though they have become firm. Two or three years ago purchasers had, so to speak, their own way as to prices, but now the situation is changed. Under these circumstances the following estimate of expenses of opening and equipping a new farm of 200 acres in Minnesota, prepared by an able farmer a couple of years ago, will be of value.

(No. 1.)

Two seeders, at $60	$120
Two self binders	570
Two wagons, at $60	120
One horse rake	30
One fanning mill	25
Two harrows	40
Two sulky plows, and two breaking attachments	120
One mower	90
Two rollers	25
One hundred sacks	22
Axes, spades, crowbars, carpenters' tools, &c	100
Total cost of implements	$1,262

(No. 2.)

Machine house	250
Barn (sheltering 20 horses, or, say, six horses and twenty cattle)	750
House	2,000
Fencing, four miles	$1,280
Total	$4,280

The last expenses would at this time be twenty-five per cent. higher on account of the rise in lumber the past two years.

(No. 3.)

Three span of horses	$750
Three sets of harness	75
Two yoke of oxen	200
Ten cows	200
Twenty young stock	200
Twenty young hogs	100
Fifty sheep	150
Household goods	500
	$2,175

CROP EXPENSES, 200 ACRES.

Breaking	$450
Back-setting	250
Seed 1½ bushels per acre	300
Harrowing and sowing	200
Harvesting	400
Thrashing	400
Marketing	100
	$2,100

SUMMARY.

Machinery	1,262
Buildings and fencing	4,280
Stock, &c	2,175
Crop expenses	2,100
Total	$9,817

PROFITS OF WHEAT GROWING.

It seems to be generally agreed that the whole expense of raising a crop of wheat amounts to $10 an acre. This would include interest on capital, wear and tear of implements, and taxes. Such sum would cover the expense where wheat is raised as the sole crop.

The items of expense of putting in and harvesting a wheat crop of 65 acres, which would be all that the labor of one man could attend to, may be estimated as follows:

Interest on capital of $1,500 in real estate at 7 per cent	$105 00
Taxes and insurance	40 00
Depreciation and use of horses and implements valued at $1,000	150 00
Labor of one man, including expense of board, lodging, and washing, four months at $30	120 00
Extra help of two men fourteen days in harvest, at $2.50 a day	70 00
Seed for 65 acres	95 00
Board of three horses, three months	40 00
Thrashing	30 00
Total	$650 00

In the above estimate it is to be understood that the wages of one man four months will pay for harrowing the ground in the spring, putting in the seed, rolling the field when the wheat is up, assisting in the harvest and thrashing, and plowing the whole field in the autumn. Where breaking and back-setting are not included, this work would be properly chargeable to a single wheat crop. There would be perhaps certain incidental expenses for travel, postage, and the like, which would need to be added. If some of the figures in the estimate are too large others are as likely to be too low, so that as a whole it fairly illustrates the average expense of a wheat crop and demonstrates that such expense is not far from $10 an acre. All, therefore, that a crop is worth above $10 an acre will be clear profit. It can be said that the best farmers average 16 bushels per acre, and assuming that they receive $1 a bushel for their wheat their profit would be $6 per acre. If they perform manual labor they would receive at least $20 a month wages besides. In addition to this, their farms are continually increasing in value. Mr. Branch, of Plymouth County, Iowa, is undoubtedly correct in saying that a yield of 10 bushels per acre "pays good expenses." He is understood to refer to crops raised by working farmers. I give entire credit to the statement of Mr. Rice, of Goodhue County, Minnesota, that a farm of 160 acres of first-rate soil, well cultivated in general crops, will give a net income of $600 to $700 per year. So the estimate furnished by Mr. Davis, an experienced and successful farmer of the same county, shows that $1,314 a year can be safely relied on as the profit of mixed farming on a farm of 160 acres. From that amount, however, I think that $400 should be deducted for interest on capital, taxes, and insurance, which would leave the sum of $700 for clear profit.

According to statistical returns in the annual report of the Department of Agriculture for 1879, the average price of wheat that year was, in Wisconsin, $1.04 per bushel, in Iowa, 92 cents per bushel, and in Minnesota, 94 cents per bushel. The census of the United States, as we have seen, shows that the average yield of wheat per acre in each of those States in 1879 was, in Wisconsin, 12.82 bushels, in Iowa 10.22 bushels, and in Minnesota 11.36 bushels. Assuming the whole expense of the wheat crop to be $10 an acre, and that the farmers received the average price in each State, the net profit of the crop was, in Wisconsin, $2.63 per acre, and for the whole State, on 1,948,036 acres, $5,123,344; in Minnesota a net profit of 65 cents per acre, and for the whole State, on 3,046,821 acres, $1,980,433; while in Iowa the net loss was 62 cents per acre, and for the whole State, on 3,049,347 acres, $1,890,595.

These figures are valuable in their bearing on the general economy of wheat growing, but being only for one year do not afford a basis for a safe conclusion in the matter. Some allowances should be made. It can hardly be assumed, for instance, that all of the farmers received for their wheat the full average price which prevailed in their respective States. Then, on the other hand, a large proportion of farmers do the work on their farms themselves and by their own boys, so that a large part of the estimated expense of $10 an acre for making the wheat crop would in their case be in the nature of wages or income. Again, something on the side of profit should be allowed for the increase in value of farm lands, well tilled, unless perchance this should be offset by the depreciation of farms that are badly tilled. So, also, while there is a necessary outfit of stock and implements for the opening of a new farm, it is to be remembered that many young men can and do successfully acquire and cultivate homesteads whose only capital to start with is their labor.

The assistant commissioners of the royal agricultural commission of Great Britain, who made an official visit to the United States in 1880, reported that the lowest price at which American wheat-growers could deliver wheat at Liverpool was 40*s.* per quarter (8 bushels). This would be at the rate of 5*s.*, or $1.25 per bushel. And even at that rate they thought "the wheat thus produced would bring on land exhaustion in time, when there would be an increase in the cost of production." So far as I can judge, the conclusion of the commissioners is sound. In producing wheat for the Liverpool market at $1.25 a bushel under their present system and with the purchase-power of money in its present state, I think the farmers of the Northwest as a whole will barely earn moderate wages.

It is admitted that unfavorable weather has, during many seasons, had a great effect in causing a poor yield of wheat, and yet it is clear that intelligent and painstaking farmers usually obtain a yield of 16 bushels per acre even in the bad seasons. The moral of this is that there must be an improved system of farming to render wheat-growing generally profitable.

Mr. John Bright, in a recent letter, writes:

> A member of Parliament, a great authority on all matters of land, whether as respects farmers or land owners, said to me about three months ago, "We don't complain of prices. Prices are high enough and good enough. What we want is sunshine and more heat, and without that there is no remedy."

Mr. Bright adds:

> The best authorities calculate that during the harvest of the last three years a sum of probably not less than two hundred million pounds sterling (a thousand million dollars) has been lost to the country as compared with the result if we had had the blessing of genial summers and of average harvests.

Sunshine and more heat! These are the things the lack of which causes distress to the English farmer and the excess of which is so often injurious to the American farmer. In a long series of years, however, the farmers of both countries can, with economy and skill, be certain of prosperity.

ROTATION OF CROPS.

In order to increase the yield of wheat, maintain a profitable cultivation of it, and at the same time preserve and improve the quality of the soil, the most skillful farmers are unanimous in recommending mixed farming, or, what is the same thing, a systematic rotation of crops. Different systems are now practiced successfully by good farmers, varying, of course, according to locality and soil. Probably the most usual as well as the most simple rotation is wheat from one to three years, then Indian corn with manure, then grass and pasturage, followed again by wheat. Another rotation is wheat, oats, corn, and then wheat. Still another is wheat, barley, oats, corn, grass. Professor Porter, of the State Agricultural College, Minneapolis, recommends the following system. He says:

> In a neighborhood like this, near cities, I would follow a rotation of wheat, oats corn, grass, and pasturage, and introduce stock. That gives me five fields.
>
> If I were a homestead settler, opening a farm on new land, I would adopt the fol-

> owing course: First year, break a field and plant on the sod with corn; then, in June break another field to be sown with wheat the next year.
>
> Second year, sow wheat on the field I broke last year for wheat, and oats where I had corn. This done, I would break another field.
>
> Third year, sow oats on the field which bore wheat last year, and plant corn on the field that bore oats. Then break my fourth field.
>
> Fourth year, wheat on new breaking (and back-setting) of last year; corn where I had oats last year; barley, seeding down with timothy and clover, where I had corn last year. Then break my fifth field.
>
> Fifth year, wheat on last year's new breaking; corn on last year's oat field; and barley, seeding with timothy and clover, on last year's corn field.
>
> Each year after this I would break the field that was in grass and pasturage the previous year to be sown with wheat the following year. Would manure only corn crops. The course of crops could be somewhat varied. For example, flax could be sown in place of barley.

It may be of practical value to beginners in farming, as well as to those who are strangers to the climate of the Northwest, to know the details of growing some of the leading crops which are profitably raised in the wheat rotation. Besides, a knowledge of these collateral crops is necessary to form a proper judgment of the economy of the wheat crop.

Indian corn.—This crop is rapidly coming into favor and importance throughout the Northwest. In 1879 the yield of Indian corn was in Dakota over 2,000,000 bushels; in Minnesota, 15,000,000 bushels; in Wisconsin, 34,000,000 bushels; and in Iowa, 275,000,000 bushels. This crop forms the basis of hog and stock raising, and may be considered the sheet anchor of agriculture in the Northwest. With this crop the farmer can use all the manure he can put upon the land and the soil is left in excellent condition for wheat.

> The best thing I have done (says Mr. Godley, of Freeborn County, Minnesota) was to raise corn and pork. My yield is 35 to 50 bushels of shelled corn per acre. * * * Ten bushels of shelled corn will produce 100 pounds of pork on feet. Where there is pasture, say of clover, pork can be produced on less corn.

The price of live hogs at that time in his locality was a little over five cents a pound. Says Mr. Johnson, of the same county:

> Late in the fall of last year I bought 40 spring pigs, and sold them early this year for $600 more than I paid for them. Spring pigs can be made to average 200 pounds each the first autumn. On a farm of 160 acres, and 60 acres in corn, 100 hogs, more or less, can be raised. A fair corn crop should be 50 bushels of shelled corn to the acre.

Mr. Burns, of Mower County, says: "With a 160-acre farm a man can make money by keeping 40 hogs." Mr. Betsworth, of Plymouth County, Iowa, whose field of ripe corn was one of the cleanest I have ever seen, and whose usual yield is 75 bushels per acre, says: "Sixty acres of corn will be sufficient to keep 100 hogs." (It may be said here that the breed of hogs now preferred is a mixture of the Berkshire with Poland China.) As an illustration of the raising of beef, partly fattened on corn, Mr. Porter, of Wright County, Minnesota, says:

> Our farmers now fatten a good deal of stock. Over 800 head of beef cattle were shipped last spring to Winnipeg from within a circuit of 8 miles, including Clearwater.

Corn, of which the Yellow Dent is the variety most common in the upper Northwest, may be grown on land which has been plowed the previous fall; but as it is convenient to haul the manure upon the land and have it spread in the autumn or winter, many farmers postpone plowing till spring. With the machinery now in use large fields of corn can be planted and cultivated with comparatively little expense. The cornfield having been plowed rather deeply and harrowed, the marker, a home-made implement consisting of four pieces of 2-inch plank raised in front like a sled runner and attached 4 feet apart, is drawn over the field with two horses. The whole field is thus marked with little furrows an inch or more deep and 4 feet apart. The two horse corn-planter machine is then driven over the field in an opposite direction. A boy or man drives the team, another rides the machine and drops four kernels of seed-corn so that the hills will be 4 feet apart. Each hill is covered by a shovel attached to the planter. A good two-horse corn-planter costs $35, a one-horse planter about $25. In Southern Minnesota corn is usually planted in the first half of May. Being a tropical plant it suffers in a cold, wet, and backward soil, and would be destroyed, when up, by a sharp frost. Much care should be exercised in selecting for seed corn which has ripened first and which has been safely housed. Refuse kernels should be excluded from the planter. Some good farmers drive the planter through the field without previously marking, dropping the kernels at intervals of 18 inches and in rows 4 feet apart. They then harrow the field several times and in different directions. When the corn is up sufficiently to see the rows—which in warm sunny weather will be within ten days from time of planting—the cultivator is put on. This implement has attachments to keep the soil from crowding on the young plant. A careful farmer will go over the field with the cultivator four times, and more if the ground is very foul. The essential thing is to keep the ground clean from weeds. When the corn is a foot or two high the flue of the cultivator is turned so as to ridge up the corn hills for the better support of the plant, attaining as near as possible to the good old-fashioned hand-hoed hills.

Some ears of corn will be ripe in August, and the soundest of these should be gathered for future seed. Generally the whole field is not ripe till the middle or latter part of September. The New England practice of cutting the stalks while green is not followed in the West. The corn is usually husked in the field from the standing stalks. A wagon accompanied by from one to five huskers passes along in the direction of the rows, and the men husk and throw the ears into the wagon, taking as many rows as there are huskers. An apt workman will husk 50 bushels in a day. The corn is stored in an airy granary where it will be safe from injury. The stalks are afterwards cut and used for fodder. The most thorough-going and economical corn-sheller costs $33, and may be used by horse or hand power.

Indian corn cannot be grown in Europe north of the Alps, and as the demand for it there is on the increase, and as it is found very profitable in the northwest equally as in the southwest of the United States for fattening pork and cattle, it becomes a crop of the highest importance in connection with a reliable wheat rotation.

Oats.—The preparation of the soil, method of culture, and of harvesting are habitually the same for this crop as for wheat. Oats should be put on the lighter soil, especially if it is to be seeded down with grass. The white variety is most in use. Two bushels are sown to the acre, with the broad-caster or drill, and they come up in five or six days. The time of sowing is not uniform. Many good farmers sow oats after their wheat crop is in, and harvest them after their wheat is harvested; others again sow before wheat and harvest before wheat. Oats are put in shock and stacked, and require to go through the sweat in stack the same as wheat. The straw being valuable for fodder, the stacks should be placed with regard to its use for this purpose. The average yield is from 40 to 60 bushels per acre, and the price 30 cents a bushel. It is considered beneficial to change the seed every few years from one soil to another.

Barley.—Barley is sown on light, but rich, mellow, and well cultivated soil. Two bushels of seed are used per acre, and may be put in with the broad-caster or drill. It is sown after the wheat crop is in, but ripens before wheat—say, in the early part of July—being the first grain crop to be harvested. It is usual to roll the ground after the barley is up a few inches. The whole treatment, in fact, is the same as for wheat. It is sensitive to frost, but not often injured by it. Care and promptitude have to be exercised in harvesting barley. A very heavy dew might discolor and injure it after it is cut. It is cut with the self-binder, put in shock the day it is cut, and stacked within a very few days after. It needs to be in stack as long as wheat, and is thrashed when the wheat and other small grain is thrashed. Only the bearded variety is used, and the yield is from 35 to 50 bushels per acre. In the middle of September, 1881, the price of barley at Le Mars, Iowa, was 50 cents a bushel, while in Milwaukee at the same time it was worth $1 a bushel. It seemed singular there should be such a difference.

In respect to rotation, barley, in England, follows a green crop—say, of turnips—and is followed by grass and clover. It has no commonly accepted place, as yet, in any rotation in the Northwest. It has been found to do well after corn and after grass, and, indeed, after any crop grown in a cleanly cultivated field, where the soil is soft and rich.

Timothy and clover.—These are found to do well in fields that have been cultivated some years, whether prairie or timber land. One bushel of timothy seed and one bushel of clover seed will be sown on 12 acres. The seed is mixed with the grain with which it is to be sown, and with that put into the ground by the drill or broad-caster. The clover or timothy may be cut for hay or for seed. The yield of seed per acre would be from 3 to 8 bushels. This season clover seed is worth $6 a bushel, and timothy seed $3 a bushel. Mr. Perkins, of Red Wing, Minn., has raised as high as 9 bushels of timothy seed to the acre and sold it at $5.30 per bushel, which, however, was an uncommonly large return. Two crops of clover may be grown on the same field in one season, but the second crop is usually plowed under instead of being cut.

Flax.—As this crop is grown to a considerable extent by those who wish a quick cash return, a few words in regard to it may be of interest. To the new settler, who has no stock to feed, the crop can be of great help, because it brings an income from the first season's breaking. In such case the breaking and harrowing ought to be finished so that the flaxseed may be sown not later than the middle of June. Three pecks of seed are sown to the acre. If sown by the broad-caster it must be afterwards harrowed in. It may, however, be put in with the drill. Where sown on land broken the year previous, or on land long cultivated, the preparation of the soil is the same as in case of other small grain. It should then be sown in the month of May. It is cut with a reaper when ripe, dried, and stacked, the same as hay, and thrashed by a thrasher with a flax attachment. The yield varies from 6 to 20 bushels of seed per acre, according to fertility of soil and pains in cultivation. The seed brings about $1 a bushel, there being several factories in the Northwest for the manufacture of oil from it. In case it is intended to use the fiber instead of the seed, the flax must be pulled before it is quite ripe. So, it is stated on good authority that tow can be profitably manufactured from the ripe fiber, provided an annual supply of 10,000 tons to a factory can be relied upon. One of the accidents from which the flax crop can suffer is blight. It is also a popular impression that this crop is very exhaustive to the soil. Hence it is not usual to raise it twice in succession on the same land.

ROTATION IN EUROPE.

As a hint of what is being done in other countries in wheat culture, I would state that at the farms of the sugar works at Cologne, on which "40 bushels per acre is considered a good crop of wheat," the course of cropping is "1st, rape, highly manured; 2d, wheat; 3d, rye, slightly manured; 4th, clover; 5th, oats or wheat, manured; 6th, sugar-beet, without manure; 7th, rye; 8th, clover; 9th, oats."

A system of rotation on one of the well-managed estates of Sweden, that at Eriksberg, is as follows: First year, rye; second or third years, grass; then oats or barley; then follow with manure; then winter wheat.

A popular succession of crops in England is the four-field or Norfolk system, in which half the arable lands are in grain crops and half in cattle crops, annually. The merit of the course is held to be that its main features can be retained, and yet extensive variation be introduced in its details. Mr. Caird gives it as his opinion that the average produce of wheat per acre, in twenty-six of the thirty-two counties of England visited by him, is 26⅔ bushels per acre; which is 14 per cent. higher than it was estimated at in the same counties by Arthur Young a century ago.

> An English farmer [said Mr. Webster after his visit to England] looks not merely to the present year's crop. He considers what will be the condition of the land when that crop is off; and what it will be fit for the next year. He studies to use his land so as not to abuse it. His aim is to get crop after crop, while still the land shall be growing better and better.

In Russia an agitation is going on for improved methods in wheat culture. The journals of that country are continually urging the necessity of introducing science in agriculture. To this end many societies have been organized; and as the Russians are very enterprising, the Americans may expect to find them strong competitors in the production of wheat. However, a large part of the wheat lands in Russia are cultivated by tenants, the proprietors living remote and being practically unacquainted with agriculture.

A PERTINENT WARNING.

Mr. Horace Capron, while Commissioner of Agriculture, delivered an address in 1870 before the Illinois State Fair, in which he gave this warning:

> Your soil is wonderfully fertile. You may be disposed to consider it inexhaustible. It is an injurious, if not a fatal, error. Statistics of production attest that repeated crops of wheat, on your best lands, show rapid deterioration. Every crop taken from the soil, with no return, reduces the capacity of the farm for production in arithmetical ratio, and its capacity for profit in geometrical ratio. Such a course may give you, for a time, a little more "ready money," but you are certainly robbing your heirs. It is doubly difficult to renovate them; how difficult you can only realize after trial. I have had a full experience of this in Maryland, having brought the value of a thousand acres, after years of labor and toil, from $10 up to $60 per acre, and repaid its cost. The difference between its original and improved yield in that period, which represents the measure of loss brought by former mismanagement, would have been a fortune in itself. I can point out farms in Maryland, thirty years ago reduced to barrenness and the meager value of $2 per acre through repeated cropping of corn and tobacco, which are now richly worth $80 through the influence of clover fertilizers, regular rotations, and judicious management generally. Then they could only yield a miserable support to their proprietors; now they maintain their owners in comfort and even luxury. It has been estimated that 100,000,000 acres of these worn-out lands have been thrown out of cultivation in the South. Beware of a similar experience in the West. You are on the road to the same ruin, which can only be averted by a prompt use of restorative agencies, and the exercise of an enlightened judgment in all the operations of your agriculture.

FARM LABOR.

So far as I have been able to learn, there is no general complaint at present among farmers in respect either to the supply or quality of labor, although in some places it is scarce. As is well understood, there is no separate class of agricultural laborers. The hands on a farm this season may be at work in another occupation next year. The harvest-field, with wages at $2.50 to $3 per day, will draw recruits from the college as well as from the ranks of those scarcely distinguishable from tramps. Of those who are on the farm as laborers one season a part will be felling trees in the pineries during the winter, others will find work in lumber-mills or in the construction of railroads, and others again will be seeking homesteads for their own possession and cultivation. A fair proportion of farm laborers expect at some time to be owners of farms. As a majority of farmers work in the field with their hired men and eat with them at the same table, they prefer, and to a considerable extent secure, for their help young men of respectability, and preferably those who live in the surrounding community.

A farmer working alone, even with the aid of machinery, cannot cultivate 50 acres in general crops, though he might alone cultivate 50 to 80 acres in small grain; but would need to work very hard. Two men can work to better advantage; and a farmer with one hired assistant from the middle of April to the middle of October could cultivate 100 acres in ordinary crops. The usual wages for a farm laborer for six months are $18 to $20 a month, with board, washing, and lodging in addition. A thoroughly trustworthy man, who could be relied on to oversee work or take care of stock in the absence of the owner, could be got for $25 a month. Wages for a man the year round would be $15 a month, besides board, lodging, and clothing. Ordinarily the laborers lodge in the same house with the farmer. Farmer and man rise the year round at five in the morning. The labors of the farm-yard, feeding the stock, milking, and the like, are attended to till breakfast, which is eaten at six or half past six o'clock. The dinner is eaten between twelve and one o'clock. Supper is eaten at 7 p. m., and frequently milking or other work about the farm is afterwards done. Not a few farmers work until dark. While some farmers will require only eleven hours of actual labor per day from their hired men, others will require twelve hours of work, if not more. Still, a good many farmers have no systematized work, under cover, for a rainy day, and are prone in such weather to spend unemployed time with their workmen in the neighboring village. Probably not above 50 per cent. of farm laborers lay up any of their wages, as they are inclined to be free with their money. The necessary expenses of a farm laborer for clothing would be $50 a year. If he has to travel a considerable distance from his home to his place of work there would be some outlay on that account.

In regard to the labor question, a very experienced and intelligent farmer of Southwestern Minnesota says:

> There has this year been difficulty in this vicinity in obtaining help. I attribute the scarcity of help to the building of so many railroads west and northwest of us, and the high wages contractors have advertised to pay railroad workmen. In some instances $2 or $3 a day have been offered to laborers in the construction of railroads. Usually a young man can be got for farm work during the winter for $10 a month with board and washing. For work during the summer season, I have sometimes given a laborer his choice either to take $20 a month with board and washing,

or $1 a day for each day that he worked and no pay for the days he did not work. Men have told me they had tried both these ways and preferred to take $20 a month. My practice is to make a conditional contract in writing with the men who work for me. Suppose the wages are to be $20 a month for the season, I stipulate with the man as follows: "If you stay till after the grain is stacked or the plowing is done, you are to have $20 a month. If you quit before harvest, then your pay is to be $15 a month." The hired man has the privilege of quitting without giving me notice, and I reserve the privilege of discharging him without notice. A farmer does not want on his place a workman he does not like.

WHEAT AND FLOUR MARKET.

A home market is always the most desirable for wheat, as it saves the expense of transportation. A steady and prosperous state of business, abundant work for the mechanic trades, extensive and skillfully conducted manufactures which regularly employ large numbers of respectable operatives, and a healthy state of industry generally—these are the conditions that make a community or a country liberal consumers of wheat flour. It is estimated that in a fairly prosperous community the consumption of wheat flour is one barrel a year to each inhabitant, and there is nothing in the official statistics that would indicate but what such a proportion of flour was consumed in the United States in 1880. According to the report of the Department of Agriculture the wheat crop of that year in the United States was 481,000,000 bushels. The acreage in wheat required, at 1½ bushels per acre, that 53,000,000 bushels should be kept for seed. There were exported 135,000,000 bushels of wheat, also 6,500,000 barrels of flour, equivalent to 28,000,000 bushels of wheat, thus making the whole export of wheat 163,000,000 bushels. Allowing one barrel of flour to each of the 50,000,000 population, the consumption of wheat in the United States was 217,000,000 bushels, so that there was left in the country a surplus of 48,000,000 bushels.

The demand for wheat flour in Europe is steadily on the increase. Among large masses of people, in different countries, who thirty years ago habitually ate black rye bread, the use of wheat-flour bread is of common occurrence. England, of course, is our principal foreign market, and it will probably continue so. Nevertheless it would not be surprising if there should be a falling off in the British demand for American wheat. Of the twenty-two last wheat harvests of England, eighteen are classed as under the average. For several years last past, and since 1874, the wheat crop there has been considerably below average, that for 1879 having been the poorest on record. It is natural that the luck should turn, and that for a series of years to come the English wheat crop should be good. So, also, it may be expected that English millers will, before long, turn to a more profitable account than they now do the hard wheat that is shipped to England from some European ports.

Meantime the farmers of the Northwest desire that something more may be done to increase the market for their wheat and flour in the West India Islands, and in Central and South America. Cuba, with 2,000,000 inhabitants, and at our very door, buys only about as much flour, annually, from this country as would make three cargoes for the new steamers which now trade between New York and South America. This singular state of things is in consequence of the Spanish tax of $6.12 levied on every barrel of American flour imported into Cuba in American vessels.

PRICES OF WHEAT.

In the past twenty years there have been great changes in the price of wheat in the Chicago market. In July and August, 1859, the price was 50 cents a bushel. In November, 1861, it was 64 cents a bushel. At the same time barley was 15 cents, corn 20 cents, and oats 14 cents a bushel. In October, 1863, wheat had risen to $1.15. It reached its highest price in May, 1867, when it was $2.85 a bushel, but fell in August of the same year to $1.55. The purchase power of money, however, at that time was considerably less than it is now. In May, 1877, the price was $1.77 per bushel. The price per bushel of No. 2 spring wheat at Chicago, November 22, 1881, was $1.25½, and at Minneapolis $1.13.

MANUFACTURE OF PATENT FLOUR.

The expense of building mills for making "patent" flour appears to have increased about 20 per cent. in the past two or three years. The cost of building such mills now would be about $5,000 for machinery, equivalent to one run of stones. If steam power were to be used, about $10,000 would be required for an engine to run a mill of the capacity of twelve run of stones; and a preference is given to certain imported iron for the construction of boilers.

Wheat-growers and others will perhaps be instructed by the following description of the present patent process of making flour, as furnished me by Mr. K. Smith, one of the proprietors of the Saint Paul Roller Mill, he being an expert in the milling business.

It consists in granulating the wheat or forming it into small grains by successive reductions on fluted chilled cast-iron rollers. There are five operations. The first is to clean the wheat by passing it through separators till it is perfectly clean. The wheat is then conveyed to what are called the ending stones, which are of sand-stone, somewhat harder than that used for buildings, and which have the shape and size of ordinary mill stones, whose action on the wheat is to remove its beard and fuzz. Having passed between these stones, it goes thence—always by machinery—to the brush machine, which is intended to remove whatever clinging dust there may be on it, and put it in the best condition for grinding. From the brush machine it goes on to the first break rollers. But these, on account of the space between them, break only a small portion of the wheat. The chop from the rollers is carried up to the bolting reels, which remove the flour and middlings from the wheat, and the latter then goes to and passes through the second break rollers, which are set a little closer together than the first. It then goes to another system of bolting reels, where the flour and middlings are separated from the wheat. Thence the reduced volume of wheat passes to the third break rollers, which are set still a little closer together than the second ones, and having passed them is conveyed to another system of bolts, which separates the flour and middlings from the wheat. From thence the wheat passes to the fourth break rollers, which are set closer together than the third, and having passed between them, it passes to another system of bolts, which separates the flour and middlings from the wheat, the latter passing next to the fifth break rollers, which are set still closer together than were the fourth. Having passed the fifth set of rollers the wheat passes to another system of bolts, which separates the flour and middlings. The remainder now reduced to bran passes to a bran-duster, which removes whatever adhering flour there may be. The latter operation finishes this branch of the milling process, and the bran, as such, is now ready for the market.

We now go back to the flour and middlings that have been produced by the separate rollings and boltings. The flour and middlings mixed as they come from the first reel or bolt of the separate bolting systems go to other bolts covered with cloth of finer mesh, which separate the flour from the middlings. The flour goes to the packer and the middlings pass to bolts called grading reels, which are covered with silks (in this country of white color) of different degrees of fineness, which separate the middlings according to their size. From the grading reels the middlings pass to the purifiers, which are machines made of wood designed to separate the light branny particles from the good heavy middlings, and which they do in two ways: one by the action of air currents; the other, and more recent method, by the application of frictional electricity. The middlings, after having been purified, pass to smooth porcelain rollers, where they are reduced to flour. From the porcelain rollers they are conveyed to a system of bolts, which remove all the coarse unground particles from the flour. The flour constitutes the "patent" flour and goes to the flour packer. The unreduced portions of the middlings pass to purifiers, where they are again purified, and then reground and rebolted. They pass through eight successive operations of that nature. The offal from the reels of the last operation passes to a bran-duster, which removes whatever flour there is still adhering to the offal. The refuse from the bran-duster is sold as "shorts."

The flour made by the iron break-rollers composes the bulk of what is known as baker's flour, except that the flour from the first break-rollers, which is very dark, goes to the low grade of flour, together with the flour from the poorest of the middlings.

It requires several hours for the wheat to pass through the different processes. It is the usual estimate that the five sets of break-rollers yield 20 per cent. of flour—"baker's flour"—and 80 per cent. of middlings. Of the 80 per cent. of middlings 45 to 50 per cent. will make the first grade of flour, 5 per cent. the low grade, and the remainder goes to the baker's grade of flour.

The operation of purifying the middlings and reducing them to flour constitutes what is understood as more particularly the "patent process." In this process it is a universal maxim that the harder the wheat is the better adapted it is to producing middlings; and with the millers the "Scotch Fife" is now the favorite variety.

It requires about 4¾ bushels of wheat to make a barrel of flour of all grades, weighing 196 pounds. There would also be about seventy pounds of offal, bran, shorts, and screenings, which latter sells for from $5 to $10 a ton, according to the season of the year. From a large milling center like Minneapolis, the offal is shipped to a distance, but elsewhere the market for it is local.

THE RENTING OF FARMS.

The farming operations of Messrs. Close Brothers & Co., in Northwestern Iowa, are likely to have an important and, I think, favorable influence on the agriculture of that region. They own or control 60,000 acres in different bodies, of which 48,000 acres are divided into farms of 160 acres; and they have the refusal of 200,000 acres of picked railroad land in adjacent counties. Mr. William Close, one of the three brothers, graduated at Cambridge College, England, in 1876, and shortly afterwards came to America, and began to search for a locality where stock-raising and grain-growing could be profitably combined. His attention was first directed to Canada; then he went to Western Virginia, where one of the brothers had already started a stock farm. After traveling through several other States, he and his brother, in the autumn of 1879, finally settled at Le Mars, Plymouth County, Iowa, on the Saint Paul and Sioux City Railroad, and were shortly joined by another brother, who had visited a more distant part of the West, and by other friends. Since that time they have been joined by 500 English settlers, the majority of whom are of such a class as to be a valuable addition to society. The Close Brothers appear to be very practical as well as energetic in their dealings. They have their office in rooms over a bank in the city of Le Mars, and do a real-estate business in connection with farming. So far as I could learn, they and their people are popular in that community among native Americans, it being admitted that their operations have been of much benefit in promoting the development of the country. That they made a good selection there can be no doubt. The land around Le Mars for many miles is fertile, with a beautifully undulating surface, and is excellently watered with streams which flow through verdant meadows, and whose banks are here and there skirted with hard-wood timber. There is no doubt of its becoming a rich country, inasmuch as corn is a sure crop there, and hogs can be raised with success. It combines the advantages of stock-raising and grain-growing in a remarkable degree.

As the Close Brothers have had more experience in renting farms than any other proprietors in the Northwest that I know of, and as there are many proprietors of extensive farming tracts who need good tenants, I will here endeavor to state what their method is. The farm is supposed to comprise 160 acres. The owner provides the land, ready for cultivation, with suitable buildings and seed; the tenant finds horses, machinery, and labor. The produce is divided between them, or the rent may be paid in cash at an average of about $2 per acre, in which case the landlord does not provide the seed. The land is supposed to have been broken and back-set. The house is as good a one as can be built for $450, under a contract for several at a time, and can thus be made cheaper than if one were built by separate contract. It is 16 by 24 feet, a story and a half high, containing a sitting-room and kitchen with kitchen cupboard, and one, two, or three bed-rooms up stairs, according to convenience. It is sealed inside with smooth lumber (it having been found that plastering is liable to be knocked down by the tenant's children), tar-papered, boarded, and battened outside. It is painted with two coats of paint, and has one chimney built from the lower floor, but no fire-place. There is not always a cellar. If one is dug, it is done by the tenant. Where a man proves to be a good tenant an additional summer kitchen is erected. The whole material is of common pine lumber, and the house is expected to require considerable repair after fifteen years. The other buildings are a stable, costing $120 to $130, sufficient for four teams of two horses each, with a loft for hay; a granary costing $100, set on brick pillars, and which, though not intended to be large enough to store all of the tenant's grain, will hold more than he requires for seed, so that he can hold some of it back for a higher market. It has a ventilator at the top; also a corn crib costing $60, on an average. If a great quantity of corn is raised a larger crib is provided. The Close Brothers offer a farm with such buildings, and 80 acres broke and back-set, the tenant to furnish all implements, stock, and labor. If they furnish the seed they get one half the crop, and the tenant the other half. If the tenant furnishes the seed he gets two-thirds of the crop; Close Brothers get one-third, and also, in such case, pay half the thrashing-machine expenses. As further inducement they sell the tenant a good horse in consideration of his breaking 20 acres, and putting it in crop with flax. They deliver the horse to him on his signing the contract, and he is to do the breaking the next year, and gives security for the execution of his contract. They reserve the right to put other labor on the farm at the tenant's exclusive charge if the work is not being done in a proper manner. The crop is divided, bushel by bushel, as it comes from the threshing machine. It is found, as a rule, that the tenant's own labor, with that of one assistant, usually a son, is enough to cultivate a farm of 160 acres if divided between wheat and Indian corn.

At first the Close Brothers furnished many teams of their own, but they had them returned in such an injured condition as made them abandon the plan of owning the stock themselves. Furthermore, they say, "we noticed that the farmers, as a class, were extraordinarily careless in the way they looked after their own horses and machinery, and we thought that if they took so little care of their own property they would take still less care of ours; also, that it would be more profitable to put into an increased quantity of lands the large amount of capital which would be needed for horses, machinery, and perishable property." Their present policy is to put in a crop of flax the same season the land is broken, and their estimate of the average yield on such land is 7 bushels per acre, which usually brings $1 a bushel. Their farms are scattered over Northwestern Iowa and Southwestern Minnesota; they have several managers who have had many years' training as farmers, and they have been successful in finding tenants. Their estimate of the farm equipments that a tenant should have is as follows:

Sulky riding plow, and one common plow	$80
Cultivator for corn	30
Two harrows	20
All other implements and tools	100
Reaper	100
Furniture, including stove	100
Four farm horses	400
Wagon and harness	100
Total	$930

To show the advantages of their system from the tenant's point of view, they give the following as an example:

> On one of our farms, in 1879, the tenant, Henry Niel, did the whole work on the 90 acres, which were sown with wheat, except the harvesting, himself. His labor was at that time worth $15 a month in the market, for eight months in the year. His plant (implements and stock) was certainly not worth $600. His returns were one-half of the crop, or 686½ bushels of wheat, which were worth $1 a bushel, or $686. If the receipts were charged with $120 for his labor, $160 for harvesting, and $62 for depreciation of plant (total, $342), his profit was $258.

RAILROAD TRANSPORTATION.

In December, 1842, Daniel Webster, then Secretary of State, wrote, in a humorous vein, to his farm manager at Marshfield:

> A member of Congress tells me that in Illinois pork is selling at $1.25 a hundred, beef at $2, and millions of bushels of corn at 8 cents. A good cow may be bought for $4. They say there is plenty of provisions, but the people are likely to starve for want of money to pay for cooking. The last news from that quarter is, that the pigs have resolved to make a strike for higher prices; they say that $1.25 a hundred will not pay for cracking the acorns.

This humorous picture by a great man, who loved agriculture with a passion, justly shows to what straits it may be reduced for want of transportation. There is no subject which more deeply affects the economy of wheat-growing. Unless the farmer can get his wheat to market at a reasonable price he might as well not produce it.

Wheat-growers have often had just cause of complaint, both on account of the high rates of transportation and the frequency with which they have been changed. Constant changes in freight tariffs are as much of an evil to agriculture as the variations in our paper currency used to be to commerce. Uniformity as well as moderation in transportation rates are what the public as well as the farmer have good reason to demand.

In September, 1865, the charge for carrying wheat by rail from Chicago to New York was 48 cents a bushel; in the winter of 1868 it was 52 cents a bushel; and the highest winter rate during the winters of 1870 to 1873 was 65 cents a bushel. In September, 1873, it had fallen to 27 cents a bushel. In March, 1873, the charge from Saint Paul to New York was 61 cents a bushel.

These examples are sufficient to show how changeable the rates have been.

Every intelligent person understands, of course, that all railroads cannot afford to carry freight at equally low rates. Quantity in a great degree cheapens transportation; and a road in a sparsely-settled country cannot do business as cheap as one in a country that is populous and productive. Some roads have much more difficult grades than others. Nor can a railroad carry freight at as low a rate per mile a short distance as it can a long distance.

The theory of railroad managers is that their local rates are reasonable and about such as they can afford to carry for; and that through rates are governed by competition. To remain in the market they say they have got to take what they can get, which sometimes forces them below paying rates. To put the local rates down to the same charge per ton per mile the road could not live. They can afford to carry cheaper for a long than a short distance, because there are certain terminal expenses which are less per mile on long than on short distances. Also, more service can be got out of cars on long runs. The principle was stated as follows by Mr. John Newell, president of the Illinois Central Railroad Company, before the Congressional Committee on Transportation to the Seaboard in 1873:

> We say that the prices we are charging for local business are fair prices, and on which only we can maintain a fair income upon the value of the roads. For when we come to a station where the business either goes away from it or is taken at a small advance over the cost, we say we will keep that business as a small help added to the general result, and enable us to make much better dividends. That is to say, if we continued our high rate we would lose entirely a traffic which pays us a small profit; and we judge it better to retain that small profit, as it helps, if you please, to keep down the prices at an intermediate station. Our position is that our prices are reasonable at the intermediate stations, and unreasonably low at the others.

Specific information as to the actual cost of transportation by railroads is remarkably scanty, but the time is not distant, perhaps, when it will be deemed beneficial for all railroad corporations alike to furnish to their respective governments exact statistics on this point.

Mr. A. J. Cassatt, general manager of the transportation department of the Pennsylvania Central Railroad, testified before the Transportation Committee in 1873 that the actual average cost of freight on that road per ton per mile was about 8 mills, which for wheat would have been at the rate of two-tenths and twelve-hundredths of a mill per bushel per mile.

Mr. Hayes, general manager of the Blue Line Fast Freight, Detroit, testified that 1 cent a ton per mile was the minimum rate at which railroads could then (1873) carry heavy freight from Chicago to New York.

At that time the maximum freight charge on the principal railroad of Sweden, owned and administered by the state, was for grain in sacks, at the rate of 1 cent 2½ mills per ton of 2,240 pounds, or three-tenths of a mill per mile for a bushel of 60 pounds, and the road was making a net profit of 5 per cent. on its capital. Also, the cost of railroads in Sweden at that time, including rolling stock and station buildings, was $45,000 per English mile.

I am informed by a skillful and experienced railroad manager that on most of the railroads in the United States it costs $1 per train mile for hauling a train of cars, assuming that the trains have freight each way. A freight train sometimes comprises 40 or more loaded cars, but taking 25 as an average number, and each car carrying 400 bushels of wheat, as is usually the case, we find that such a train would carry 10,000 bushels. This quantity at $1 a mile would be at the rate of one-tenth of a mill, one-twentieth of a cent. per bushel per mile. The cost of transporting 10,000 bushels of wheat from Chicago to New York on the shortest railroad route, which is a distance, say, of 1,000 miles, would be $1,000, being at the rate of 10 cents a bushel. The cost of transporting 10,000 bushels of wheat from Saint Paul to New York, a distance of, say, 1,400 miles, would be $1,400, or at the rate of 14 cents a bushel. Now, however, freight cars are being made and extensively used which carry, each, 600 bushels of wheat. Allowing, therefore, 25 such cars to a train, the cost between Chicago and New York would be reduced to six cents and six-tenths of a mill per bushel, being at the rate of sixty-six hundredths of a mill per bushel per mile. At the same rate the cost from Saint Paul to New York would be 9 cents and 3 mills per bushel.

It may be interesting here to notice that during the summer of 1881 the all rail charges for wheat from Chicago to New York were from 6 to 12 cents a bushel. No higher rate than 15 cents a bushel was asked.

From Saint Paul to Chicago, during the same time, the rate was 12 cents a bushel, making the lowest actual all-rail rate between Saint

Paul and New York from 16 to 22 cents a bushel. On the 15th of November, 1881, this through rate from Saint Paul to New York was advanced. Between Chicago and New York the rate was fixed at 12 cents a bushel, and from Saint Paul to Chicago 15 cents a bushel.

The advance naturally has had the effect to greatly stop the shipment of wheat between the two latter points. Formerly the Saint Paul wheat-buyers had relief in such cases by sending their wheat to Duluth and leaving it in store till the opening of navigation; but now the Saint Paul and Duluth Railroad, which was originally endowed by a liberal land-grant and by a large donation of money by the city of Saint Paul, is controlled by the Chicago, Milwaukee and Saint Paul, and the Chicago and Northwestern Railroad Companies, and the freight on that road has been advanced to 12 cents a bushel from Saint Paul to Duluth, being double the former rate.

The local rates on roads leading from the agricultural districts to Minneapolis and Saint Paul are much higher in proportion, being about 12 cents a bushel per 100 miles, and are regarded by the farmers as exorbitant.

It can reasonably be assumed that when the improvements of navigation under the present projects on the Mississippi River shall be completed, and which ought to take place inside of three years, the wheat-growers of the Northwest will be able to send their wheat to New York at 10 cents less per bushel than they now usually pay.

At the beginning of August, 1881, when No. 2 wheat was selling at $1.20 per bushel of 60 pounds in Chicago, the railway freight from that city to New York was 6 cents per bushel, or 48 cents per quarter of 480 pounds.

The freight from New York or Philadelphia to Liverpool was 3*s.* 6*d.*, (87 cents) per quarter (8 bushels) by steamer, or 11 cents per bushel. Elevator expenses at the port of shipment were nearly 3 cents a bushel, making the whole freight from Chicago to Liverpool, say, 20 cents per bushel. This was at a time when the "cut rates," or through business, were in operation.

It requires a week for wheat from Chicago to reach New York by rail, and three weeks by canal. From Chicago to New York by way of the Erie Canal the freight for wheat was about 7 cents per 100 pounds, or 4 cents and 2 mills per bushel.

WATER TRANSPORTATION.

The safe and successful use of those two great natural water-routes to the sea—the Mississippi River and the northern lakes—is a matter of the highest concern to the agriculture of the Northwest. These routes when properly improved will, as has just been said, afford much cheaper means of transportation of grain than can be expected by railway. They will serve assuredly to even and ameliorate transportation charges by railway. They have an important influence in that respect even in their present condition for it is well known that on the opening of navigation the great railway lines from the seaboard to the West naturally reduce their own rates and keep them down till navigation again closes.

The very location of all our great cities speaks to the paramount importance of navigable routes of commerce. There is scarcely a leading city in the republic but is situated on a navigable route. Not to mention those on the seaboard, how strikingly is the fact illustrated by those in the interior. Where are those commercial marts, Chicago and Milwaukee, but on Lake Michigan? Where are Buffalo, Cleveland, Toledo, and Detroit, but on the lakes? Where are those prominent cities of Pittsburgh, Cincinnati, and Louisville, but on the Ohio River? Where Saint Louis, Cairo, Memphis, and New Orleans, but on the Mississippi? It is hardly necessary to bring a mass of dry figures to show to the products which crave an outlet on our inland waters, for these cities which have sprung up on their banks are fresh and significant proofs of the vast interests connected with our leading water-routes.

Considering that our country is at such a safe distance from the great powers of the world that it is not liable to be mixed up with their quarrels, and is thus exempt from the burden of great standing armies and the dangers of foreign wars to which those countries are liable, it has seemed to me that she has been somewhat slow in improving her naturally magnificent water-routes.

Before Washington was born, Peter the Great had initiated those canals by which the Volga system affords a navigable route a distance of 4,000 miles through the heart of Russia, from St. Petersburg to the Caspian, and on which 8,000 vessels now annually ply.

THE MISSISSIPPI RIVER.

When we remember what sacrifices were made in the civil war to open and to hold the Mississippi River; what large sums were spent from first to last in operations along its shores; what numbers of the youth of the country succumbed to climatic exposures, to severe labor on fortifications, and to the perils of siege and battle, in order that the great highway might be opened; what memorial could be more fitting or more grateful, in honor of those sacrifices, than the making that river forever a safe national channel for peaceful commerce? Such, indeed, would seem now to be the enlightened purpose and policy of Congress and the government. Remarkable improvements of the navigation of the Mississippi have been accomplished since the civil war. The improvements over the South Pass, near the mouth of the river, and known as the Eads jetties, resulted last year in producing a practical navigable channel over 25 feet deep, and abundantly ample for a loaded ocean steamship of fully 3,000 tons.

Capt. W. H. Heuer, of Engineers, United States Army, inspector of improvements at the South Pass of the Mississippi River, in his official report, dated New Orleans, July 21, 1880, says:

An examination of the report and charts show that at the end of the fiscal year there was, through the jetties, a channel 30 feet deep, having a least width of 40 feet, while the 26-foot channel has a least width of 200 feet. Near the Head of the Passes, in the channel, there is but one spot having a less depth than 26 feet. At this point the depth is 25.6 feet. One year ago the depth at the same place was 24 feet. In other words, there is now a ship-channel from the Gulf of Mexico into the Mississippi River 200 feet wide, and having a depth of 26 feet, except in one little spot just referred to.

It seems now to be a settled fact that there will soon be practical navigation for the very largest ocean steamers from the mouth of the Mississippi up to the city of New Orleans.

THE DES MOINES RAPIDS.

Another recent improvement of great importance has been the construction of a canal at the Des Moines Rapids, which are 11 miles in length. It is thus briefly described by the Chief of Engineers in his annual report for 1880, Appendix T:

The present project for this improvement was adopted July 19, 1867; the object being to secure a channel over the rapids, navigable at all times, with 5 feet depth at the extreme low-water stage of the river. This has been essentially secured by the construction of a canal along the west river-bank from the city of Keokuk, Iowa, to the village of Nashville, Iowa, a distance of 7.6 miles, and open cuts through the chains and patches of rocks from Nashville to Montrose, Iowa, a distance of about 3.5 miles. The canal is 300 feet wide, with the exception of a little less than 2 miles of its length, which is 250 feet wide. The open cuts, when finished, are to be 200 feet wide. The natural channel over the rapids was extremely narrow, crooked, and difficult to navigate even at medium stages of water, and was utterly impassable at extreme low-water for boats of ordinary size; and even lumber rafts were often broken up, and a large part of them lost, in making the passage. The amount expended to June 30, 1880, is $4,303,495.06 for construction of improvement, and $127,565 for operating and maintaining the canal since the opening, August 22, 1877, and has resulted in essentially completing the canal, and making a fairly-passable channel above the canal. The balance of the amount appropriated up to date, $67,439.94, and the amount asked for, $136,580, are to be applied to the completion of the improvement, and to operating and maintaining canal to June 30, 1882.

IMPROVEMENT OF THE MISSISSIPPI RIVER FROM SAINT PAUL TO DES MOINES RAPIDS.

The official report for the year 1880 of Capt. A. Mackenzie, Corps of Engineers, states:

Under this appropriation are carried on works for the improvement of through navigation. These works consist of brush and stone dams for closing side chutes and subsidiary channels, and for contracting the width of water-way, and also of brush and stone shore protections for caving banks. * * * The results already obtained show that the system of improvement adopted will give in time a good channel sufficient for all purposes of navigation, and the main question of the future is a reduction in the expense of dams and shore protections and the adoption of temporary expedients for assisting navigation until the channel is so regulated that it will maintain itself.

This officer recommended an appropriation of $500,000 for continuing the improvement of the Mississippi River between Saint Paul and the Des Moines Rapids, a distance of over 500 miles, for the fiscal year ending June 30, 1882. Congress, however, appropriated only $200,000.

It is the opinion of the engineers that, in order to carry on the improvements in a systematic manner and with the best economy, there should be a yearly appropriation of a fixed sum, so that they would know in advance how much work could be done and prepare accordingly. The suggestion is important and should be acted on. Under large appropriations, too, work can be done much more economically than under small ones, contractors and the government being able to put into the field sufficient labor, steamboats, barges and the like, which could not be done in the case of small works. Besides, when a work is begun it should be completed at once, otherwise the results may be lost, owing to frequent changes in the river. Strange as it may seem, no thorough survey of the Mississippi River between Saint Paul and the mouth of the Illinois River was ever made till within the past three years. Its result shows that there are eighty bars between the points mentioned which must be improved before there can be a channel of 4½ feet depth at extreme low-water all the way to Saint Paul. The distance from the latter place to the mouth of the Illinois River is 650 miles, in which are included many long stretches now good and which may not need improvement for many years to come. When prices were low, say in 1878, an approximate sum of $10,000 per mile was estimated as the expense of making a 4½-foot channel at low-water between the two points mentioned, but since the advance in prices the engineer in charge thinks that a complete improvement will greatly exceed in cost that estimate. Those figures, however, he thinks, are sufficient to secure a 4½-foot channel, and the increase would be the cost of maintaining and making it permanent. For the fiscal year ending in 1883 he has asked an appropriation of $750,000 between Saint Paul and Des Moines Rapids which, he says, will permit of allotting enough to the river above La Crosse to secure 4½ feet to Saint Paul, certainly in two years and probably in one year. It is obviously the truest economy for the government to make its appropriations for these improvements in a fixed and permanent manner and on a scale such as the engineer officer deems necessary. Then hold the engineers accountable for faithful work. As has been said, the method of improvement being carried out is simply the closing of all side sloughs and the contraction of the main river to such a width as will maintain a sufficient depth for navigation.

The improvement of the navigation of the Mississippi above the falls of Saint Anthony is a matter of direct practical importance to agricultural interests, but scarcely needs to be discussed here.

THE BARGE LINE ROUTE.

With a certainty of 4½ feet of water in the Mississippi River up to Saint Paul during the season of navigation, wheat could be shipped on barges down the river to New Orleans and thence by steamer to Liverpool or Glasgow at the rate, say, of 25 cents a bushel for the whole trip.

On the 27th of July, news by cable was received at Saint Louis of the arrival at Glasgow, in excellent condition, of the 30,000 bushels of wheat which had been shipped on two barges at Saint Paul June 7. The barges were built at Saint Louis, and were such as are in ordinary use, being constructed with the same material, thoroughness, and care that would be used in the building of steamboats themselves. They are made to carry freight on deck as well as in the hold. Being designed, however, especially to carry Indian corn and small grain, an air-chamber or open space 2 feet wide is left around the sides and bottom of the hold. There are two objects for leaving so much space, one being to prevent damage to goods in case the bottom or sides are broken by snags or otherwise, and the other to keep the grain cool. Beside this space on the sides and under the hold, an open space of 2 feet deep is left between the grain and the deck. There is therefore a current of air all around the grain. Hitherto, barges on the Mississippi have carried more maize than other sorts of grain, and as the former is more apt to heat than the smaller grain, the barges that will be safe for that must necessarily be safe for wheat. In respect to this shipment of wheat by barges June 7, it may be remarked that the weather was changeable during its passage, and included very unfavorable spells that were hot, wet, and absolutely muggy; indeed, a number of rumors, which turned out to be unfounded, were in circulation to the effect that the wheat had been damaged by heat on its passage down the river. Also, this particular wheat, though put on two barges at Saint Paul, was finally, and before reaching Saint Louis, transferred to the larger of the two barges, and thus reached Saint Louis on one barge. This was done by the machinery, a floating elevator, without loss of time while moving down the river.

The freight charge on this wheat by barge from Saint Paul to New Orleans was 25 cents per 100 pounds, and a similar rate in bulk from New Orleans to Glasgow, equivalent to 14½ cents a bushel from Saint Paul to New Orleans, or 29 cents a bushel from Saint Paul to Glasgow. On the arrival of the cargo at Glasgow it was short only 1 bushel and 33 pounds, while the shortage usual via. New York is said to be 1½ per cent.

Lest it be thought that such shipping of wheat in bulk to Europe by the way of New Orleans was a novel experiment, I would state that wheat was so shipped ten to fifteen years ago.

The depth which wheat has in such a barge, as above mentioned, is 5 or 6 feet. An advantage in transporting wheat by rail is that it is in transit a much less time than it would be in barges. On the other hand, as the roof of a car is covered with metal and the grain within it comes near to the sides, it is not likely to be so cool while it remains in the cars as it would be in a barge such as has been above described.

The British grain merchants, I am told, shrug their shoulders when one speaks to them of shipping wheat by the New Orleans route, as much as to say there is danger from heat. The weight of testimony, however, and the result of experience, would show that the route is a safe one.

THE NORTHERN LAKE ROUTE.

Very important improvements are being made on the Northern Lake route, which, when completed, will admit the passage of vessels drawing 16 feet, from the head of Lake Superior and from Chicago to Buffalo. Likewise the Welland and the Saint Lawrence Canals are undergoing alterations, which will allow vessels to pass from Lake Erie to Montreal, drawing 14 feet of water. Lake Superior pours its mighty volume into Lake Huron through the Saint Mary's River, and it is at the falls (called by the early French settlers the "Sault") of this river that an enlarged canal and lock have just been completed. The project for this canal and lock, as stated in the report for 1880 of the Chief of Engineers, was adopted in 1870, and that for the improvement of the river in 1879, the object of the work being to procure a 16-foot channel from Lake Superior to Lake Huron in place of one scarcely 12 feet. The amount expended to June 30, 1880, was $1,797,514.

This new lock of the Saint Mary's Falls Canal was completed and opened in August, 1881. It is 515 feet long, and will admit a vessel drawing 16 feet and not over 60 feet wide. Before, however, vessels drawing 16 feet can pass all of the way from Lake Superior to Lake Huron, the channel must be deepened at various points in the Saint Mary's River.

The Canadian Government had begun the improvement of the channel of the river, but stopped as soon as it saw the United States was also improving it. All the improvements required, including the alteration of the old locks, the opening of Hay Lake Channel, and the improvement of the East Neebish Rapids, can be completed by the end of the season of navigation of 1882, thus furnishing an available 16-foot channel from Lake Superior to Lake Huron, provided Congress will promptly make the necessary appropriations.

To get from Lake Huron into Lake Erie and thence to Buffalo on its eastern shore, we must cross Lake Saint Clair, and go down the Detroit River. Here, also, is some obstacle to vessels drawing 16 feet. At a place called Limekiln Crossing, where a bed of limestone underlies the Detroit River, the water is only about 13 feet deep. The project for its improvement, so as to obtain a channel of 20 feet in depth, was adopted in 1874. The amount expended to June 30, 1880, was $99,817, which resulted in removing 8,400 cubic yards of limestone. The sum of $50,000 for continuing the improvement was appropriated by the act of March 3, 1881, and the sum of $186,000 is still needed to complete the work.

If, then, Congress (at the session which is to commence in December, 1881) will promptly make the necessary appropriations, the route will be completed from Chicago and Duluth to Buffalo for vessels drawing 16 feet of water and of capacity to carry the immense quantity of 100,000 bushels of wheat at the opening of navigation in 1883.

The improvements in question are all under the charge of Maj. Gen. G. Weitzel, a conscientious and skillful officer of the Engineer Corps, who is well remembered in the civil war for the distinguished part he took in the capture of Fort Fisher.

THE WELLAND AND SAINT LAWRENCE CANALS.

It will be well, of course, to always keep in mind the benefits that may accrue to the northwestern farmer by continuing the water-route from Lake Erie to Montreal, by way of the Welland Canal. Still, it cannot be expected that Montreal will as a rule afford as cheap ocean freight as New York, for the reason that there are so many more large steamers, loaded with immigrants and with goods, coming to that city than come to Montreal, and which can afford to take return cargoes of grain at low rates. Mr. Thomas Rimmer, formerly president of the Board of Trade of Montreal, in his statement before the Transportation Committee, at its session at Montreal, in September, 1873, said, speaking of the wheat trade:

> The New York purchaser and we ourselves are exactly on the same footing; we both pay the same price in the market; but we can bring it here much cheaper than the New York merchant can take it to New York, and, we believe, also in better condition. We bring it in colder waters and in larger bulks; our barges bring 20,000 bushels down the canal, whereas down the Erie you bring 7,000 or 8,000 bushels; and we think the larger barge, drawing 8 or 9 feet, and colder water, brings it in cooler condition. That is the general experience we have. But when we get here we are at a disadvantage as compared with the New York shipper, for we have to pay a higher ocean freight, chiefly because New York is such an immense place for imports and for immigration. There are so many of those enormous steamers—the National Line, the Williams & Guion Line, and the Inman Line will very often bring out a thousand emigrants, and they can afford to go back all the cheaper. A great number of the vessels arriving this year have come in ballast.

The Welland Canal leaves Lake Erie at Port Colborne, about 15 miles west of the city of Buffalo, and crossing two counties in the province of Ontario, enters Lake Ontario at Port Dalhousie, opposite Toronto. Its length is 27 miles. It was commenced in 1825 and opened in 1833; enlarged from 1842 to 1845 to double its original capacity, and is now again being enlarged under the plan adopted in 1875 to a depth of 14 feet, so as to pass vessels of fully 1,000 tons burden, which is six times greater than its original capacity. The work in progress is expected to be finished by 1884.

What are known as the Saint Lawrence canals comprise the Cornwall, Lachine, Williamsburg, and others along the waters of the Saint Lawrence River between Lake Ontario and the harbor of Montreal. Descending the Saint Lawrence from the lake, the first obstacle consists of Galop's Rapids. Here a canal 7½ miles long was completed in 1856.

Instead of enlarging the canal the present scheme is to deepen the channel of the river. Four and a half miles below Galop's Rapids begins the Rapide Plat Canal, which is 3¾ miles in length, and which was built to overcome a fall of 11 feet in the river. Ten miles below commences Farran's Point Canal, which is about three-fourths of a mile long, and was completed in 1847. The three last-mentioned canals are called collectively the Williamsburg canals, and are on the north side of the river.

The Cornwall Canal, also on the north side of the river, commences 5 miles below Farran's Point Canal, and has its confluence with the river at the town of Cornwall. It is 11½ miles long; was the first constructed, and is the largest of what are known as the Saint Lawrence canals.

The next is the Beauharnois Canal, 11¾ miles in length, situated on the south side of the river and built to avoid the "cascades," and connect Lakes Saint Francis and Saint Louis.

The last in the series is the Lachine Canal, which begins at the village of the same name, just above the city of Montreal, and terminates at the harbor of Montreal. It is 8½ miles in length, and in those sections near the harbor has a capacity for vessels drawing 18 feet.

From Montreal to Quebec the distance is 160 miles. Midway between those cities the Saint Lawrence widens into Lake Saint Peter, where formerly were shoals at a depth of 11½ feet. These were deepened to 20 feet by works commenced in 1844 and completed in 1865. Usually, therefore, vessels drawing from 18 to 23 feet of water can come up to Montreal. From Quebec to the sea there is always sufficient depth for the very largest vessels.

It is expected that the enlargement of the Saint Lawrence canals under the present project will be accomplished in course of six or seven years.

The treaty between the United States and Great Britain of May 3, 1871, which so happily settled the Alabama dispute, also guaranteed to Americans the free navigation of the Saint Lawrence River and the use on equal terms of the Welland and Saint Lawrence Canals. Article 26 of that treaty provides:

> The navigation of the river Saint Lawrence, ascending and descending from the forty-fifth parallel of north latitude, where it ceases to form the boundary between the two countries, from, to, and into the sea, shall forever remain free and open for the purposes of commerce to the citizens of the United States, subject to any laws and regulations of Great Britain, or the Dominion of Canada, not inconsistent with such privilege of free navigation.

Article 27 of said treaty provides:

> The Government of her Britannic Majesty engages to urge upon the Government of the Dominion of Canada to secure to the citizens of the United States the use of the Welland, Saint Lawrence, and other canals in the Dominion on terms of equality with the inhabitants of the Dominion; and the Government of the United States engages that the subjects of her Britannic Majesty shall enjoy the use of the Saint Clair Flats

> Canal on terms of equality with the inhabitants of the United States, and further engages to urge upon the State governments to secure to the subjects of her Britannic Majesty the use of the several State canals connected with the navigation of the lakes or rivers traversed by or contiguous to the boundary line between the possessions of the high contracting parties, on terms of equality with the inhabitants of the United States.

When all of the improvements now in progress on the Welland, Saint Lawrence, and other Canadian canals shall be completed, their whole cost will have reached a sum of nearly $50,000,000, which is a generous expenditure for a country whose population is not much larger than that of the State of New York. These canals will have a very important influence in promoting competition for the Montreal route. And the result will probably be that the State of New York will take measures to cheapen transportation on the Erie Canal. The city of New York will endeavor to attract the bulk of "western" products that are intended for export. Anyhow, the improvements in navigation which the Canadian Government is so liberally and successfully carrying into effect should stimulate the United States to do with promptitude the work that belongs to them.

Repeating words used by me on another occasion, I would ask, Does it ever occur to people why the United States are free from the expense of navy-yards and armed fleets on the northern lakes, notwithstanding their opposite shores belong to a powerful foreign nation? In 1817 the United States, through Richard Rush, entered into the following arrangement with Great Britain, proclamation of which was made by President Monroe the 28th of April, 1818, namely:

> The naval force to be maintained upon the American lakes by his Majesty and the Government of the United States shall be henceforth confined to the following vessels on each side; that is:
>
> On Lake Ontario to one vessel, not exceeding 100 tons burden, and armed with one 18-pound cannon.
>
> On the upper lakes two vessels, not exceeding like burden each, and armed with like force.
>
> All other armed vessels on the lakes shall be forthwith dismantled, and no other vessel of war shall be there built or armed.

This important international stipulation was modestly called an "arrangement." It did not take the dignified form of a treaty, but surely no grander provision was ever introduced into a treaty. By this "arrangement" the great American lake system was dedicated to peace. As one result from it our government has been relieved from naval expenditures of many million dollars. President Monroe, in his annual message of 1817, did not exaggerate in saying:

> By this arrangement useless expense to both sides, and, what is of still greater importance, the danger of collision between armed vessels in these inland waters, which was great, is prevented.

Previous to this "arrangement" there were nine British war vessels on those waters, capable of carrying three hundred guns, though not all were in use. The United States had the year previous to this "arrangement" on Lake Ontario twelve war vessels, with capacity for three hundred and sixty guns; on Lake Erie six war vessels, with capacity for one hundred and eight guns; and on Lake Champlain seven war vessels, with capacity for one hundred guns; though all the vessels of course were not afloat.

It is safe to say that by this statesmanlike and beneficial disarmament of the northern lakes, which has been in effect for over half a century, the United States have saved in naval expenditure more than five times as much as would be required to put their navigable capacity within the reasonable requirements of commerce. Does not such a fact render it all the more imperative on our government promptly to improve the northern lake navigation as fully and thoroughly as practicable?

CAPACITY OF STEAM BARGES THAT WILL PASS THE SAINT MARY'S CANAL.

It may well be doubted whether ocean steamers will in the near future do much of the wheat-carrying trade from the upper lake ports. The transshipment of grain is now done so cheaply and speedily by machinery that it is probable the bulk of the wheat exported to Europe from the Northwest by vessels will be taken from the upper lake ports on the newly modeled transports and thence transshipped, say at Buffalo or Montreal. It becomes, therefore, quite interesting and important to know the capacity of the vessels that will probably carry wheat through the Saint Mary's Canal. Through the kindness of Mr. George H. Ely, of Cleveland, Ohio, who for several years has been effective in promoting the improvement of lake navigation, I have been furnished a statement of the capacity of such vessels, prepared by Mr. H. J. Webb, of Cleveland, one of the best authorities in such matters. It bears date October 26, 1881, and is as follows:

STATEMENT OF MR. H. J. WEBB.

A craft 275 feet keel, 44 feet beam (width), and 24 feet depth of hold, drawing 16 feet, would cary 100,000 bushels of wheat, or 3,000 net tons. She would have steam power to tow two consorts of equal capacity, and make 10 miles per hour. While running by herself she could average say 12 miles per hour. Thus one steam barge equipped with consorts—the cost of such consorts being only a little over one-half of the cost of steamer—moves through the lakes 300,000 bushels of wheat, or 9,000 tons, in one tow.

A vessel 250 feet keel, and 40 feet beam (wide), and 21 feet hold, drawing 14 feet water, would carry 75,000 bushels of wheat, or 2,200 tons. A vessel of similar dimensions, drawing 14½ feet water, would carry 80,000 bushels, or 2,400 tons.

The last dimensions given, drawing 14 feet water, and 14½ feet to 14 feet 10 inches, is the largest class of steam barges now in use upon our Northern lakes. But each year, as business increases, our crafts are made larger, rivers are deepened, and canals made deeper and wider. Since I have been connected with the lake shipping—say, twenty-five years—a craft 60 feet keel, 9 feet hold, and 18 feet beam, with capacity of 7,000 bushels of wheat, was called a big vessel, and fears were entertained by the owners of such vessels that they could not find business to employ them for only about

> one-third of the season at remunerative rates. But to-day we call a 60,000 to 70,000 craft a medium-sized craft.
>
> A craft could be built, and no doubt will be in the near future, suitable to pass through the Saint Mary's Canal. The dimensions and capacities of such boats would be about as follows: We must understand if such vessels have large beam (width), length and depth of hold must correspond. Thus, if we build a craft, say, 55 feet beam, she must be 350 feet keel and 28 feet hold, in order to be strengthened and fastened in proportion. Such a craft would carry, on 16 feet of water, 150,000 bushels of wheat, or 4,500 tons; on 14½ feet of water, about 4,000 tons.
>
> Many of our modern crafts are built of iron, and we shall no doubt grow into that entirely very soon, for the reason that boats built of wood, iron-fastened, will run out of class (standard-class as to insurance of cargoes) in ten years, while iron boats would hold their class thirty-five to forty years. Such crafts as I mention as being now in use have netted the owners upon their investments at least 20 per cent. These barges and their consorts are provided not only with powerful engines but with sails, and can withstand the roughest lake gales.

The depth of the Saint Mary's Canal and River, and at the Limekiln Crossing of the Detroit River, when the improvements are completed, will be 16 feet. A vessel drawing 16 feet water and of the capacity of 150,000 bushels of wheat, would not be laden to her fullest capacity so that she would actually draw 16 feet. For the purposes of active navigation it may be assumed that the largest cargo of wheat that a vessel will take through the Saint Mary's Canal will be 140,000 bushels.

It may be of interest here to state also that there is a difference between the registered tonnage and the carrying tonnage or capacity of vessels. A steamer known and classed as of 2,000 tons, and registered so at the Treasury Department, usually has a carrying capacity of 25 per cent. above that amount. Thus a steamer of 2,000 tons can carry 2,500 tons of freight. On the other hand, barges and schooners have a carrying capacity 90 per cent. above their registered tonnage. Mr. Ely remarks:

> It is certainly true that the style of build of our lake vessels drawing, say, 14 and 16 feet water, represents a larger wheat-carrying capacity than sea-going steamers drawing only the same amount of water. The latter are not so broad beamed, in proportion to depth of hold, as our lake craft; for instance, a 3,000 "registered" ton ocean steamer could not carry her real capacity without having water enough to "load down," which might require 20 or 22 feet. * * * The largest steamers now in use on the lakes could use no more than 16 feet water if all the channels through the lakes permitted them to do so.

Farmers and others concerned in the speedy improvement of the Mississippi River and northern lake navigation can promote the same by urging the matter on the attention of their Senators and Representatives in Congress.

STATEMENTS BY EXPERIENCED WHEAT GROWERS.

The following statements of experienced wheat growers and practical farmers were mostly made to me verbally, in reply to questions, and if they should seem anywhere disconnected the fault will be mine rather than that of the person communicating the information. The order in which the statements are presented has some regard to the latitude in which the farmers reside.

Statement of Dr. A. C. Wedge, Albert Lea, Freeborn County, Minnesota.

I have cultivated wheat more or less for the last twenty-three years. In 1859 I raised about 30 bushels to the acre. The decreased wheat yield noticeable in the past few years may be attributed to two or three causes. Naturally the first is the exhaustion of the soil by continued growing of wheat on the same land. Another cause seems to have been the extreme heat which has prevailed in recent seasons, when the wheat was about in the milk. Wheat now does much better on new soil than on old. The trouble with wheat is a matter of a good deal of conjecture and theory. It has seemed to me that the dryness of the soil is one cause of the failure, and I think the wet season we have just had, causing the ground to be well soaked a depth of 2 feet, will prove beneficial to next year's crop. The farmers also think the wet will have killed off the chinch-bugs which have been troublesome in the eastern part of the State. Seeding the ground down with timothy and clover, deep plowing, and a rotation of crops are the best means I know of to promote an increase in the yield of wheat.

Statement of Mr. A. M. Johnson, Freeborn County, August 23, 1881.

[Mr. A. M. Johnson, Albert Lea, resides in the town of Manchester, and has raised wheat in Minnesota eighteen years. The soil of his farm is similar to that of the greater part of Freeborn County, which is considered a very good farming county, namely, a dark loam, a little sandy, with self-draining clay, mixed subsoil of light color, and blue clay after going to a depth of 10 to 15 feet. He says:]

There are two elements operating against us in raising wheat: First, atmospheric; and second, the exhaustion of the elements of the soil by constant cropping. We are all going out of wheat raising as fast as we can. There is general despondency in regard to wheat growing. Recently we have been threatened with the chinch-bug. The yield of wheat in my neighborhood this year is 10 to 12 bushels to the acre. To increase the production we must manure the soil and practice a rotation of crops. Four years ago we had 25 bushels to the acre, and some, on new breaking, had 40 bushels to to the acre. That was in 1877, and was a favorable year. The weather that year was favorable for wheat. When I began to raise wheat my yield was never less than 20 bushels to the acre. It cannot be denied that insufficient pains are taken in the selection of seed. We ought to select for seed wheat the plumpest kernels, and sow these only. I do not believe that wheat will deteriorate as seed on the same field if care is taken to get plump kernels for seed. In seeding I have uniformly used the broad caster, and harrowed the ground afterward. Rolling is good after the wheat is up. However, the practice of rolling wheat fields is not common. There are no such implements as rollers in the market, and, perhaps, this fact may account for the infrequent practice of rolling.

The use of the harrow and the kind of harrow to use depend on the soil. The "boss" harrow with steel teeth is a good harrow for light soil. You could, with that, harrow 30 acres in a day. On heavy soil I would recommend using a heavier harrow.

Wire is now discarded in binders. Twine only is used.

In regard to the *labor question* there has this year been difficulty in this vicinity in obtaining help. I attribute the scarcity of help to the building of so many railroads west and northwest of us, and the high wages contractors have advertised to pay railroad workmen. In some instances $2 or $3 a day have been offered to laborers in the construction of railroads. Usually a young man can be got for farm work during the winter at $10 a month, with board and washing. For work during the summer season I have sometimes given a laborer his choice either to take $20 a month, with board and washing, or $1 a day for each day that he worked, and no pay for the days he did not work. Men have told me they have tried both these ways and preferred to take $20 a month. My practice is to make a conditional contract in writing with the men who work for me. Suppose the wages are to be $20 a month for the season, I stipulate with the man as follows: "If you stay until after the grain is stacked or the plowing is done you are to have $20 a month. If you quit before harvest then your pay is to be $15 a month." The hired man has the privilege of quitting without giving me notice, and I reserve the privilege of discharging him without notice. A farmer does not want on his place a workman he does not like. Hired men in this part of the country eat at the same table with the farmer's family, and lodge in his house. If a separate lodging house were provided for workmen it would lead to disorder. In case a man is engaged who is suspected of being a tramp, he does not have accommodations just the same as those given to workmen whom we know to be respectable. Bedding is provided for such a hand that can be more conveniently washed. The taking of strangers into a farmer's house when he may be in need of labor sometimes causes anxiety.

[The day on which this conversation took place with Mr. Johnson, the weather was rainy, and the principal street seemed filled with countrymen; and in answer to a direct question he replied that he thought too many laboring men were accustomed to visit towns on rainy days, as there might be work of some sort which a thrifty farmer could find for his man to do.]

The farmers have great reason to complain in regard to the charges for transportation. There are combinations or "rings" of wheat buyers, and among railroad companies. Farmers have suffered from these combinations. Although we are friends to railroads, and desire them to enjoy their rights, and wish that more railroads may be built, we, nevertheless, desire to be protected in the enjoyment of our own rights.

The summers in Minnesota appear to be growing warmer, and less suited to wheat. They are becoming, however, better adapted to corn raising, and one important means of relief for farmers is to raise more corn and fatten hogs. Late in the fall of last year I bought 40 shoats, spring pigs, and sold them early this year for $600 more than I paid for them. Spring pigs can be made to average 200 pounds each the first autumn. On a farm of 160 acres and 60 acres in corn, 100 hogs, more or less, can be raised. A fair corn crop should be 50 bushels of shelled corn to the acre.

Owing to our railroad communication with Saint Louis the potato crop this year is quite a paying one. Fifty-three cents a bushel are now being paid for potatoes for shipment to Saint Louis. Potatoes can be grown much easier than wheat. In planting potatoes the ground is first marked. The potatoes are covered with the sulky plow, two of the shovels being removed. One team of two horses can cover 10 acres of potatoes in a day. Hand hoeing is not practiced. In six or eight days after planting it is usual to harrow the potato field. The weeds are afteward kept down by the plow.

Statement of Mr. John Godley, Albert Lea, August 22, 1881.

[The situation of Mr. Godley's farm of 240 acres is uncommonly attractive, being a mile and a half south of the city of Albert Lea, on ground sufficiently elevated to command an extensive view of the surrounding country, which is almost wholly under cultivation, and dotted with farm buildings and groves. The soil varies from 1 to 3 or 4 feet depth of loam, with yellowish clay subsoil, twelve feet below which one comes to blue clay. Mr. Godley is a native of England, from whence he evidently brought some ideas and habits of farming. His statement in regard to wheat culture was substantially as follows:]

My land has been cultivated from seven to ten years. For the last three or four years I have not raised less than 13 bushels of wheat to the acre, but before that the yield was 22 bushels per acre.

The variety of wheat has been "Scotch Fife." The seed was purchased here, and I have raised the same sort right along. I have, however, cleaned the seed by passing it three or four times through a fanning mill, and, in addition, the use of a sieve by hand to get out the small kernels and cockles.

I cannot say that I have a system of rotation, though I have tried rotation as far as I could. Have never raised wheat continuously on the same land for more than three years. After three years of wheat, have changed to corn or oats. Have not plowed deeper than 7 inches on account of grubs, but would have done so if the ground had permitted. I harrow the ground before seeding, put the seed in with a broad-caster, and afterward harrow once, twice, or three times. Never have rolled the ground after seeding. Do not think rolling is now practiced about here; those who tried it had discontinued the practice. Wheat with us is ready to cut from the 22d of July to the 18th of August, generally—say, about the last week of July. It should be cut when the kernel is doughy and there is no milk in it. My practice is to stack just as soon as I get through cutting, and sometimes while cutting. As near as I can judge the sweating in the stack is over in the course of three weeks. I have found that in a week or ten days after stacking the wheat is in such a state that it cannot be thrashed. It adheres closely to the husk. Am of the opinion it pays to put the wheat through a fanning-mill before taking it to market. The buyer will deduct at least a pound of wheat per bushel if it is not well cleaned.

Have not heard of the use of salt on wheat land about here. Where wheat is to follow a crop of corn there is danger of over-manuring the corn crop. In that way I once nearly spoiled 30 acres of wheat, the yield being only 11 bushels per acre. I have never tried clover as a rotation with wheat, nor have I tried wheat after timothy. I do not know of anything that troubles wheat about here but hot weather, which causes it to ripen prematurely, and hot weather immediately following wet weather. There were a few chinch-bugs about here last year, but none this season. There are, however, many this season on sandy land about three miles from here.

The best thing I have done on my land was to produce corn and pork. For corn I plow the land in the spring. Have tried plowing in the autumn and in the spring, and for corn prefer the latter. The manure is spread on first, and some of it could be hauled in winter, but the greater part of my farm-yard manure I use on grass land. Generally I have from 30 to 50 acres in corn each year. The average yield is 35 bushels to the acre, or, say, from 35 to 50 bushels per acre of shelled corn—the Yellow Dent variety. The marker I make myself, and use two horses with it, marking the ground in checks so that the hills will be 4 feet apart each way. In planting I prefer the hand planter, as the corn is more effectively covered by that. One man will plant and cover with the hand planter from 5 to 8 acres a day. Planting by hand has the further advantage of making straighter rows, so that the plowing between the rows can afterward be done more successfully. I harrow immediately after planting, and then two or three times afterward, and until the corn is three inches up. Plow it four times, twice each way, continuing the plowing as long as I can without breaking the corn down. Always hoe my corn once, not in the old-fashioned thorough way of forming hills, but to chop out the weeds. In this way a man can go over 2 acres in a day. The corn is harvested, say, from the first to the middle of October. Sometimes cut it up, sometimes husk it on the hill, yet generally cut and shock 10 to 15 acres.

I now have 60 hogs of Berkshire and Poland China breeds crossed (pure Poland

China hogs are black and white color, and Berkshires are black with four white feet and white stripe in the face). It is scarcely any more trouble to take care of 50 hogs than of 10; and I would think a man ought to take care of 50 on a farm of 160 acres. Ten bushels of shelled corn will produce 100 pounds of pork on feet. Where there is pasture, say, of clover, pork can be made on less corn. If the corn is shelled and soaked twenty-four hours, which is the way I feed it, then 8 bushels will produce 100 pounds of pork. I have tried unground barley, boiled, and found it excellent food for pigs. I feed my hogs with some corn all through the summer, and from this time (on August 22) give them all they will eat.

[Mr. Godley's hogs were as fat and fine a lot of hogs as I ever saw. They had an excellent pasture, in which were a few acres of ground adjoining the piggery well shaded by oaks. In the chamber over the piggery were one hundred or two hundred bushels of corn in the ear, also an excellent corn-sheller.]

My corn sheller cost $33 here. It was intended to be run by horse-power. One of these $10 shellers, which I formerly had, I found useless. I feed my hogs twice a day, and now give them as much as they can eat. The price of hogs alive is now a little over 5 cents per pound.

Statement of Mr. Monn, Albert Lea, August 22, 1881.

I have 2,300 acres in wheat this year in different localities. I let the land out to neighboring farmers in quantities of 50 to 100 acres, and always furnish the seed, "Scotch Fife," myself, taking pains to get good and pure seed. I frequently visit these farms and find it mutually beneficial to confer often with the men who rent them of me. The land is mostly new. Some of it has been in crop eight years and a part of it only three years. It has never produced less than 12 bushels to the acre; some of it will yield about 18 bushels to the acre. Shall seed down 400 acres in timothy and clover to rest it.

One point in wheat culture is to plow early in the fall. By that means the foul weeds sprout up and then die. Besides, it is essential to wheat to have the ground packed hard. The amount of harrowing in the spring depends on the condition of the soil.

Am very particular in cleaning the seed. The best mill for this purpose is an inclined plane called a cockle mill; it takes out the cockles, small kernels of wheat, &c. This year we have not an armful of foul stuff in 100 acres. Two seasons I got seed wheat from along the Northern Pacific Railroad, but the crops failed. The straw did not have strength enough. I now claim that it is better to take seed south of where it is to be sowed rather than north.

Wheat should be sowed early, and all the work in its culture should be done well. Many farmers get discouraged and neglect a part of the work, but they are beginning to take more pains in cleaning seed. I have not yet tried salt on the wheat crop. The burning of straw scattered over the field is beneficial.

In regard to farms of 160 acres each, I would say that on an average only 90 acres would be available for field use on such a farm. The kind and cost of implements on a farm of 160 acres would be as follows:

One self-binder	$300
One mower	70
One rake	35
One seeder	60
One wagon	60
One harrow	12
Two teams (four horses)	500
Two plows	40
	$1,077

These would have to be renewed every five years. Standard machines are all good.

Statement of Mr. H. N. Ostrander, Albert Lea, August 24, 1881.

[Mr. Ostrander has a farm of 160 acres, 4 miles north of the city of Albert Lea, and has for many years paid special attention to the growing of spring wheat. With reference to the repeated failures of the wheat crop in Southern Minnesota for some years back, Mr. Ostrander said:]

I have not had a really good crop of wheat since 1877. That year I raised over 40 bushels to the acre, and never saw anything like it. I attribute the remarkable yield mainly to the weather, because similar seed and care have been used other years when the crop has been a failure. The weather during the summer of 1877, or while the wheat was maturing, was favorable. It was generally cool, and yet there was some hot but dry weather. There was no very hot weather immediately following rain. My wheat crop of 1878 was almost a failure on account of blight. The seed which I sowed that year was from the best of the crop of 1877. The crop of 1879 was better than that of 1878, but not good, being only about 13 bushels to the acre. In 1880 I had 17 bushels to the acre of "Scotch Fife." I have been using the same sort of wheat grown on my farm for the past 12 years, and I claim from actual experience that wheat will not deteriorate if proper care is betowed on the selection of that which is used for seed. The crop of 1877 was from wheat which had been grown several successive years on my farm. I clean my seed with a machine of my own invention, and also cleaned considerable seed wheat for others with it. The main part of the machine consists of two lengths of screen or sieve, the upper length inclined in one direction and the lower one in an opposite direction. The wheat before getting through the machine passes over 7 feet in length of the screen. There are no fans to the machine. Having been very careful of my own wheat for several successive years, and sometimes picking the seed over by hand, it is necessary to put my own wheat through the machine only once in order to get it perfectly clean of cockles, and especially the shrunken and defective kernels. Other wheat has to be put through the machine several times. Farmers in general use fanning mills to clean their seed wheat, but they are insufficient to take out all the cockles and small kernels.

I regard it important for the success of the wheat crop that the autumn plowing be done early and that it be deep. It benefits the soil to get the green matter plowed under deep. The foul matter does not start so soon. It is beneficial to roll the ground sometimes, but a man must exercise judgment in regard to it. I have noticed sometimes that in the three inch wide track of the wheels of the broadcaster the wheat has been 3 or 4 inches higher and better. A roller with cogs making indentations in the ground which could catch the soil that might be blown would prove beneficial.

I harvest my wheat when it is in the stiff dough and appears green. I would have it put in large shocks if the weather is dry and stack it by all means. The sweating depends much on the weather.

I do not pickle my seed wheat, but I formerly washed it in brine to prevent smut.

One man can do the work of 40 acres. With a hired man, say from April 1 to December 25, in addition to the farmer's own labor and a few days' extra help in harvesting, from 80 to 90 acres can be cultivated. More attention should be given to mixed farming. As to the number of hogs that could be annually fattened on a farm of 160 acres I should say that one hog might be furnished to the market to each acre of corn produced, with the understanding that reasonable pasturage and some other food were provided besides.

Statement of Mr. Spicer, Albert Lea.

A year ago there was dissatisfaction here on account of railroads and wheat "rings." The Milwaukee price was taken out of wheat that was shipped to Minneapolis. A remedy would be to raise a moderate sum of money and buy wheat. This would be easy, because as soon as the wheat is on the cars you can draw on Chicago or Milwaukee for it.

Statement of Mr. Nicholas Burns, Austin, Minn., August 22.

[Mr. Burns rents 300 acres of good prairie land near Ramsey station, and has land of his own in Murray County. He is a native of Ireland, where he learned and practiced farming, and has had many years of agricultural experience in the United States, being now about sixty years of age. He says:]

To work this farm I employ four good teams of two horses each, and keep two men steady the year around, besides extra help at harvest time. Plow the ground early and deep in the fall. I use three or four horses in plowing, and plow up the subsoil. In the spring I sow wheat without harrowing, and would treat clay soil in the same way. The soil here is black sandy loam. The benefit from not harrowing before sowing is that the seed gets better covered. I use the broadcaster for sowing, and take 1½ to 1¾ bushels per acre for seed; drag (harrow) the field after sowing with the spring-tooth harrow the same direction I sow. I then have the ground harrowed with the steel-tooth harrow in a diagonal direction to that in which the wheat was sowed, and after that harrow again diagonally to the last harrowing. As a general thing, roll the ground as soon as the wheat is in and continue rolling. Sometimes the wheat will be 4 inches high before the rolling is done.

My rule is to get the seed in the ground early—as soon as the frost is out of the ground—a depth of 3 inches. I use the "Scotch Fife" and change the seed every year, and get what has been grown on black loam or clay soil. Never have applied salt to the land, but if it was my land would do so. When the wheat is in a stiff dough and the field has a bright golden color I begin to cut. Leave it in shock not over a couple of days, and then stack it. Am in favor of large stacks. The diameter of a good stack should be about 18 feet at the bottom and about 24 feet 5 feet from the ground. The quicker the grain is in stack the better. It requires to be in stack three weeks, and the sweating is then through. It takes a week to begin to sweat, a weak in the sweat, and a week to get dry. I use wheat straw for bedding in the stable and for fodder. It is also beneficial to spread it over the field and burn it. The wheat comes from my thrasher sufficiently clean to take to market.

The great defect in farming with us has been the continued growing of wheat for so many successive years on the same land. Until I took this farm it had been cropped twenty-two years, and the yield had become reduced to 5 bushels of wheat per acre. The next year, 1877, the season was very favorable for wheat, and I raised 22 bushels to the acre. That fall I covered 60 acres with farm-yard manure, planted with corn the next season, and had a big crop of corn. The following year sowed the same field with wheat and averaged 15 to 16 bushels to the acre of good quality of wheat, although the season was a poor one.

I raise both the Yellow Dent and White Dent corn. My practice is, in raising corn, to plow the ground in the fall, having had the manure spread first. Harrow in spring. With two horses draw a marker over the field and plant with machine planter. The "marker" is a home-made instrument, consisting of four pieces of 2-inch plank, each raised in front in form of a sled-runner, and attached 4 feet apart. In drawing this implement over the field each strip of timber or marker makes a narrow little furrow an inch and a half deep. After this the corn-planter is driven over the field in an opposite direction. A boy drives the team, another rides the machine and drops four kernels in every hill. A shovel is attached to the planter, which covers the corn. A good two-horse corn-planter costs $35. A one-horse planter costs from $15 to $25. It is usual to plant corn from the 6th to the 15th of May—the sooner in Minnesota the better. After the corn is up and 1 or 2 inches high, I harrow it if the ground is weedy. When it is 3 or 4 inches high, I commence plowing it with a two-horse sulky plow. Sometimes I plow corn five or six times, and always continue the plowing until the corn is too high to admit of it. The last time of plowing I turn the plow-shovels so they will throw the earth on the hill and cover up all the weeds. A boy twelve years of age can do the work. At $10 a month, board, &c., a boy can be hired who, with one team, will tend 60 acres of corn. I cut the most of the corn for feed; husk it in the field, and stack the fodder. Have, on an average, got 60 bushels to the acre. It is a safe crop here every year if one attends to it. With a 160-acre farm a man can make money by keeping 40 hogs.

Statement of Mr. Ellis, Austin, Mower County, Minnesota, August 24, 1881.

[Mr. Ellis is a leading stock farmer in Mower County, having a farm of 800 acres, and has been engaged in farming in Minnesota since 1857. A very interesting feature of his place near Austin is the avenue of pine trees leading from the main road to his dwelling. The trees are 15 to 20 feet high, growing in a very thrifty condition, and forming a very pretty drive-way 30 feet wide and a quarter of a mile in length. One sees now in Southern Minnesota frequent displays of taste in the matter of tree-planting. Most of the trees that are planted, however, are Lombardy poplar or cottonwood. Why not on light soil plant groves of white pine? They would prove profitable, as well as ornamental. Mr. Ellis says:]

My wheat crop was good in 1877, but has been poor ever since. I, with other farmers, am about discouraged in raising wheat, and am getting out of it as fast as possible. This season I raised the "Lost Nation" and a Russian variety. The crop had a heavy straw, and the yield will not be over 15 bushels per acre. On account of handling so much straw I will not make as much from it as many other farmers who had only 10 bushels to the acre. I was one of the first farmers in this part of the State to raise red clover, and have had good success with it.

Statement of Mr. H. F. Kohlmier, Houston County.

I have been engaged in farming in Houston County since 1857. The yield of wheat has been growing less for some years back, and was only about 5 bushels per acre the present season, the variety being mostly "Lost Nation." Even on newly broken land the yield is much less than it used to be, from which it would seem that the decrease in yield is owing largely to climatic causes. The light yield on old land must also be a good deal in consequence of the exhaustion of the wheat-producing qualities of the soil. The best way to restore the yield is to raise different crops, and especially clover.

In 1856 spring wheat was successfully grown where I lived, in Northern Illinois, but its culture there has since failed.

The farmers in Houston County, for a few years back, have been raising a good deal of corn, and working into a rotation of crops. Corn does very well on the old wheat land. We have gone into hog raising a great deal, but this season the hog cholera made its appearance, coming from Iowa, and has done a great deal of damage. The farmers have lost thousands of dollars this season in consequence of it. The disease is contagious. It is a fever. The hogs that have it suffer a good deal in the head, and may linger for several weeks. They sometimes reel about, seeming to be dizzy. Sometimes the disease is attended with diarrhœa and sometimes with constipation. Hogs that have the cholera show no appetite for food.

The stormy weather this autumn has injured the corn crop seriously. The ears have been thrown upon the ground and the corn has begun to grow.

Usually, a farmer with a hired man will cultivate from 80 to 100 acres, and the practice in my county is to work fully twelve hours a day. Wages are $20 per month.

My opinion is that it is best in cultivating wheat to plow the ground early in the fall, even if it is dry. The advantages from so doing are that the stubble gets decomposed, and the seeds of the weeds spring up and are winter-killed; whereas, if they were plowed under late, they would remain in the soil to grow up in the spring.

Statement of Mr. Barr, Nobles County.

I began wheat-growing in Southwestern Minnesota in 1873. My first four crops in succession were destroyed by grasshoppers. Then, in 1877, I had a very good crop.

My last crop cost me over $1 a bushel, and I sold it at 75 cents a bushel. A farmer in my part of the State this year had 100 acres in wheat, none of which is worth cutting. The soil is good, but what most injures wheat is the occurrence of wet and hot weather at the same time. Many farmers now cultivate flax, the yield of which may go from 15 to 20 bushels of seed per acre, and as low as 6 bushels to the acre. In sowing flax the practice is to sow three pecks to the acre, with a broadcaster, and then harrow. Nothing further is done to the crop until it is ripe, when it is cut with a reaper. It is dried and stacked the same as hay, and thrashed with a flax attachment. In case it is intended to use the fiber instead of the seed, it must be pulled before it is quite ripe. It is generally sown in May, yet may be sown as late as the middle of June. This late period at which it can be sown gives it a certain advantage, it being sometimes sown on new breaking and helps to rot the sod. Flax is a crop which exhausts the soil, and it is not usual to sow it twice in succession on the same land. Some soil may be too rich for flax grown for the fiber, as it will make too coarse a fibre.

Oats are a good crop to follow flax. Sometimes corn is planted after it. It is a fact that flax can suffer from blight.

The failure in wheat makes it necessary that farmers should turn their attention more to stock. They must, of course, go slow, as they came here expecting it was a wheat country. They cannot change their system at once. My section of the country is supplied with a good breed of hogs—the Poland-China. However, one trouble in raising hogs is that our winters come on suddenly, and then it is hard to get the hogs along.

Statement of Mr. Valentine, Saint Paul, August 15, 1881.

[Mr. Valentine is manager of one of the principal elevators at Saint Paul.]

My wheat farm in Redwood County has soil such as generally comprises first rate prairie land west of the "big woods"—black loam 2 or 3 feet thick upon mouse colored clay. Have been engaged in wheat-growing the past six or seven years; and owing to grasshoppers, blight, &c., have had poor success up to this year. Have had to dig for my information on wheat-growing to gain it by experience, as I found very few who could give me the desired information. The best place for wheat is in the northwestern part of the State. Even that soil will wear out. It can be kept up, but not so readily as where tame grass will grow. Possibly, however, tame grass may prove successful there. Clover is now being raised successfully, where twenty years ago it was thought impossible to raise it. For example, in Washington County I am going to experiment with "Blue Joint." I think it may be improved upon and cultivated as a tame grass. A great merit with "Blue Joint" is that it can be cut from about the middle of August up to the time of frost. It is an important fact that natural grass, if mowed too early in this country, will gradually die out.

There is more money in raising corn and hogs in this state than in raising wheat. More can be made in raising hogs than any other sort of stock.

This year I tried the "Blue Stem" variety of wheat. Got the seed in Saint Croix County, Wisconsin. It is a hard wheat, and derived, according to my information, from the "Velvet Winter." Winter wheat to be raised as spring wheat must be got by successive crops. Winter wheat will not the first season give a good crop if sown in the spring. I think the "Blue Stem" will prove superior to the "Scotch Fife." Where I sowed the "Blue Stem" early this season—which was, however, no earlier than May 6—I shall get a good crop, say 20 bushels to the acre, where my neighbors will get only 5 bushels per acre. A portion of it was sowed as late as two weeks after May 6.

One of the most valuable facts I have been able to gather, and through my own experience, is the use of salt. Last year I applied salt to 125 acres; this year to 1,600 acres. Had the salt sowed by hand broadcast from a wagon, as soon as possible after the wheat was sown. Used 200 pounds per acre, at a cost of $1.20 per acre, including material and labor. The salt was the common crushed agricultural salt. Think this application of salt will increase the yield 100 per cent. Last year the increase was 40 per cent. Salt will prove more valuable than any other manure on barley and oats. On flax, would put only 100 pounds per acre. Have used plaster of paris without any effect.

Salt checks the weeds and promotes the stalk and berry of the wheat. This season has been a wet one on the lands referred to. Would think salt would have even a better effect in a dry season.

Prefer shallow breaking—only 2 inches. Sod would rot better in a dry than in a wet summer. It is indispensable to back-set. I use a sulky plow.

The most profitable system here in Minnesota would be to break the land and sow flax the same season. As a rule the crop would pay for all the work, including breaking and back-setting. Where it is the intention to put in flax, I would break 3 inches deep.

Some land will want harrowing once or twice, and some will want five or six harrowings. If I want to give the land extra cultivation, I use the seeder as a cultivator. The best seeder I have ever used is the Buckeye.

Usually land is not sufficiently harrowed and prepared for the crop.

In sowing, my experience is against the drill. It might answer in sandy soil, but not in rich loam. The broadcaster is better. Finish covering with the harrow.

I have rolled wheat fields, applying the roller after the wheat was a few inches up, but do not find the practice beneficial.

Never have pickled seed. It could only be conveniently done in farming on a small scale.

The right way to harvest is to go at it just as soon as it will do.

Ordinary farmers can thoroughly clean their wheat with the common fanning-mill; also clean flax in the same mill. A machine that will clean out the cockles costs $15. Farmers could club together to get these machines.

Statement of Mr. Bettsworth, Le Mars, Plymouth County, Iowa, September 14, 1881.

[Mr. Bettsworth has a finely situated farm of 280 acres a mile from the city of Le Mars. He states:]

I have been engaged in farming here for the past sixteen years, having been one of the earliest settlers in this part of Plymouth County. I formerly farmed in Northern Illinois, where "Canada Club," a soft variety of spring wheat, was cultivated a number of years, but finally failed, as "Scotch Fife" has done here. I have raised "Scotch Fife" every year for the past fifteen years, except this. For the past few years it has not done well, and this year I tried "Sea Island" and got 20 bushels to the acre. Have never used salt in wheat, but think it would do well. In respect to rotation, I have succeeded better with wheat after corn, and have sown the wheat on the ground without plowing. In such case I have the cultivator follow the broadcaster; then harrow twice, the last time crosswise. Use 1½ to 2 bushels of seed and sow early—as soon as frost is out of the ground. For seed I select the best and first ripened wheat, and have it cleaned with a separator, which takes out all the cockles. Usually roll it after it is up. The only trouble about rolling is that we do not have rollers that are heavy enough. The time to cut wheat is when it is in the dough—in that condition that if you squeeze a kernel it will come out in a bunch. I never have had wheat hurt in the stack. If properly stacked it is just as safe as in a granary. It wants to be in stack three weeks so as to go through the sweat. I have tried winter wheat here, but it spring-kills. I use wheat straw for feed. For corn I manure the land heavily with barnyard manure, my usual yield being 75 bushels to the acre. Corn land cannot be too heavily manured. I have had many loads of manure brought from the town. I use the "Yellow Dent," and for seed pick out the first ripened ears—some are ripe as early as August—and hang them up with the husks tied together. In planting I use a Keystone planter, and drive it through the field without marking. The planter drops three or four kernels—depending on the size of the kernels—at intervals of 18 inches and in rows 4 feet apart. The harrow follows the planter, going in different directions, and generally going over the field three times. When the corn is up sufficiently to see the rows, put on the cultivator, with attachments to keep the soil from crowding on the young plant. I generally go over it with the cultivator four times, and more, if the ground is very foul. The main thing is to keep the ground clean from weeds. When the corn is big enough turn the flue so as to ridge the earth for its protection. When ripe and husked it can, at any time, be put in an airy granary and be safe from injury; but in an unventilated granary it would heat. A team with one to five huskers will husk five rows. One man should husk 50 bushels in a day; however, there is a great difference in men. One man may have a knack at the work and do twice as much as another.

Sixty acres of corn will be sufficient to keep 100 hogs. It pays to soak corn before feeding it. Soaked barley will make a pig grow better, but, all things considered, there is no food so good for a hog as corn.

I have found barley to do well on the same field twice in succession. It requires low, strong land; should be sown early—next after wheat; and sometimes may be sown in March. I do not consider that it is liable to danger from frost. One and a half bushels may be sown to the acre. Heavy dews tend to color barley. What is cut one day should be stacked the next. I do not bind it into sheaves, but stack it loose. The ordinary yield is 25 to 40 bushels per acre. Barley straw makes excellent fodder.

Oats should also be sown early, say 2½ bushels to the acre. I would not manure the ground for oats; have had good luck plowing them under; 50 to 75 bushels are a good yield. I had 75 bushels to the acre last year and about 60 this year. I prefer the white oats, as I consider them better for horses than black oats, though the latter weigh heavier than the white. Oat straw also makes good feed.

Farm implements with good care will last from five to seven years.

A 16-inch plow, turning a furrow of that width, is intended for three horses. Its cost is $50. A 12-inch plow would be used with two horses. I have not cultivated flax.

Statement of Mr. Peter Branch, Le Mars.

[Mr. Branch, a native of Belgium, who has had over twenty years' experience in raising spring wheat in the Northwest, and whose farm, on which he resides, is a few miles distant from Le Mars, states as follows:]

In 1877 I raised 15 bushels of wheat—"Scotch Fife"—per acre on old ground. In 1878 I had 20 bushels per acre on new ground, and a like yield the next year on the same ground. This year my yield is 10 bushels per acre. The cause for so small a yield this year was that I seeded too late, the last week of April, which was in consequence of the season being backward. A crop of 10 bushels to the acre, however, will pay good expenses. Wheat should be sown in the spring as soon as may be. For seed, my practice has been to select the best wheat I can see in the field as it is ripening, even if in different spots, and keep it specially for seed. I have it thoroughly cleaned in a fanning-mill; sow with broadcaster and harrow once. I do not roll the ground; and, so far as I know, it is not the practice to roll. Cut about the last week in July, but it must not get too ripe. Stack as soon as cut, and in tolerably large stacks. The wheat should be in stack six weeks or two months. I aim to get through the fall plowing before thrashing. Never have had wheat hurt in the stack except the first year I began farming in Minnesota; had never tried to make a stack before. I had a *very* little manure on my wheat land last year, and it did well.

I have, every few years, manured my wheat ground just a little with good success. But very little manure must be used. Have never tried salt. I raise "Scotch Fife" every time. This year "Sea Island" does better than "Scotch Fife," but not other years.

In new breaking I would plow only 2 inches deep, and back-set an inch deeper. In fall plowing, I plow deep. Generally farmers do not (in their stubble plowing) plow deep enough, and, as a consequence, in dry weather, wheat will suffer in a week. Two and a half acres, on old land, can be plowed in a day well enough. A man can plow 3 acres in a day. In Minnesota, after raising wheat several years, we would manure the land and raise corn, and then raise wheat again, with a favorable result. I do the same for barley as for wheat—sow early, just as soon as I am done with wheat. I do not put on manure for barley, but select the richest parts of the field on which to sow it. Have raised barley three times in succession on the same ground. I would take barley after wheat. Have raised it every year successfully, say 400 or 500 bushels every year, with an average of 50 bushels per acre. That is my yield this year. It ripens before wheat, and is not hurt by our weather. I sow here the first week in April, using 2 bushels of seed per acre, and putting it in with the broadcaster the same as wheat. It comes up in five or six days.

I would sow barley before sowing oats. I cut it (with self-binder) before harvesting wheat, and put it into shock the same day it is cut; and when it is dry, stack it. Can stack in a week after it is cut.

It will dry in the stack, and should remain in stack a little longer than wheat. I thrash all at the same time. In Stearns County, Minnesota, I used to get $1 a bushel for barley; now I get 50 cents a bushel. I observe that the season here for sowing is about two weeks earlier than it was there.

For oats, I prepare the ground the same as for wheat or barley, and sow 2 bushels to the acre with broadcaster, harrowing afterwards. Sow right after barley is sown. Oats will come up in five or six days. Select the poorest of my land for them, and do not manure. I always cut them when thoroughly ripe; use twine binder the same as other grain, and put them in shocks. Would expect oats to be cut after wheat and barley. Would leave them in stack six weeks or two months. They should be in stack three weeks anyhow; they must go through the sweat like other grain. I raise between 50 and 60 bushels of oats per acre every year; sold my oats at 30 cents a bushel this year. I raise 50 bushels of corn to the acre; put the seed in with the corn planter, which covers it. Pay a man for husking by the bushel. It is better to pay for labor by the piece where it can be done. One man should husk two common wagon-loads full in a day. I plant corn from the 10th to the middle of May. It is best to plant early. Have heard many about here say that 100 hogs can be fattened from 100 acres of corn. Have not yet tried any tame grass, as I have enough wild.

So far as I know the spinning and weaving of wool by farm women is not practiced about here. This used to be done among the Germans where I lived in Minnesota.

Have never tried raising flax; but I think it is not good for the soil.

On an average on 160-acre farms there will be about 125 acres suitable for field culture.

Statement of Mr. O. A. Moore, of Le Mars, September 14.

I have farmed twelve years in Northwestern Iowa. Hard wheat did well here until three years ago. In 1878 the blight struck it, and the next year the grasshoppers. The yield this year is not over 4 to 6 bushels. The decline in the yield of hard wheat led me to try a soft variety called the "Sea Island," and brought to this locality from Cherokee County, Iowa. The "Sea Island" yielded here last year from 22 to 28 bushels to the acre. They grind it at the mill here, and make good flour. This year's crop is not thrashed. My idea is to sow spring wheat as soon as the frost is out of the ground. Our experience here is that wheat does not do well after corn; it grows too much to straw.

It is generally sown with a broadcaster, but in a dry time the drill does best. I have always rolled wheat after it is up from 4 to 6 inches. Commence cutting just as soon as it is in the dough, and stack as soon as it is dry enough. Have commenced harvesting wheat the 6th of July. When the wheat is dry and the weather is dry it will not get through the sweat in stack sooner than four to six weeks. Have thrashed six weeks after staking, and found that the wheat was not out of the sweat. It was tough and difficult to thrash.

Never found cockle in my wheat till last year, when it came with the "Sea Island" seed. Have cleaned the seed through a fanning-mill. We never raised No. 1 wheat here but one season, namely, 1877. I do not know of any one who has tried salt on wheat fields.

Corn does well continuously on the same ground. All the manure obtainable is put upon the corn ground, but it amounts to little. The varieties planted here are White and Yellow Dent, and the average yield is 45 to 50 bushels per acre. Eighty acres of corn will carry 100 hogs. It will take two hands and two teams to cultivate the 80 acres. The practice here is to husk in the field, throwing the ears into the wagon as they are husked. Fifty bushels of shelled corn, equivalent to two large loads of ears, make an average day's work at husking for one man. If there are three or four men to a wagon they will not do so much, as they are hindered more or less by talk, and are also in each other's way. My plan is to have one man to a wagon. Husking generally begins in October. Last year there came a big storm which proved the beginning of a remarkably early winter, and the corn was not husked; people could not get into their fields. I saw the other day a corn field not yet husked. As before stated, 80 acres of corn will fatten 100 hogs. A good deal of pork is produced about here, and the hogs are usually killed when eighteen months old. We could not now succeed so well with spring pigs, because they are not enough milk daries here to give the spring pigs the start they need. They must first get a frame before being fattened. In wintering them I have kept them in pastures with free access to wheat stacks, and where they could follow the cattle. They find a shelter under the straw; I do not house them; if the ground is muddy in autumn, I provide a feeding floor. The pasture fence consists of two boards and two wires.

For oats I prefer the same soil as for wheat. Sow with the broadcaster early; as soon as the frost is out of the ground. I use two and a half bushels of seed to the acre, harrow it in, and roll the ground after the crop is up about 4 inches. Late sown oats are liable to rust. Cut in July, and as soon as they are dry stack. It has been my practice to cut them high; have never bound them into sheaves. I cover the oat-stacks with a little hay. Oats must go through the same sweating process as wheat. The average yield is 40 bushels to the acre. I have raised as high as 100 bushels to the acre. Oats do well after corn.

I used to raise 40 acres of barley a year, but it is an uncertain and treacherous crop. The same weather that rusts wheat and oats turns the barley kernel dark, and hurts its market. Barley is adapted to rich, damp soil, and for this crop the soil may be manured. I would prepare the soil just as I would for wheat or oats, but would sow later, and when there is no danger from frost. One must be careful about the seed. If it has been heated in the bin it will not grow. It has less vitality than any other grain. I sow about two bushels and a peck per acre. If the ground is rich it does not require quite as much seed. Sow with the broadcaster; but if it is a dry year, with the drill; to cover the seed, would harrow once, and if the ground is rough, twice. Roll after it is up 4 inches. Barley matures a little ahead of other grain, its harvest commencing usually right after the 4th of July. Cut with self-rake reaper, but be careful not to cut till the dew is off; would stack it the next day. I would let barley get a little riper than other grain before cutting—say, till it is stiff in the dough. It wants to go through the sweat in the stack, requiring, say, from four to six weeks. Thirty bushels per acre is good average yield.

Kentucky blue grass has been introduced in this vicinity with good success. The practice is to sow it in the spring on the natural prairie, after it has been burnt over, and in a wet time. The seed is sometimes harrowed in. I consider that this blue grass has four times the value of native grass. I have had clover which survived three winters.

Good help averages $20 a month the season through—say, about eight months. Farm machinery, on an average, will not last over seven years, under good care; to last so long as that it must not be put in the fence corners. Five years is a good life for a plow, but one can be worn out in three years. A harvester can last from seven to ten years if properly housed.

Statement of Mr. P. Gallagher, Le Mars.

I have farmed here thirteen years in succession. In 1879 I raised "Scotch Fife" and "Sea Island" wheat, two twenty-acre tracts lying side by side. The ground had been summer fallowed, and the weeds plowed under. The seed was put in early. The hard wheat was injured by rust, and of the whole 20 acres I got but 100 bushels. The adjoining 20 acres of "Sea Island" yielded 25 bushels to the acre. In 1880 I tried both hard and soft wheat again, the hard yielding 6 or 7 bushels per acre, and the soft 20 bushels. This year had hard wheat on land where I had corn last year, and did not cut any. I think my soft wheat this year will average 12 bushels to the acre. Have sown wheat after corn, the latter being manured and plowed in the fall.

In cultivating flax I plow the ground in the autumn, harrow in the spring, sow three pecks of seed to the acre with broadcaster, harrow the seed in the same as any other grain, and harvest it the same as wheat. Leave it out ten days in a good dry season, and then stack it. The ordinary yield is 10 to 14 bushels per acre. I have only 5 bushels of flaxseed this year on land where I had corn last year, but the ground was plowed late in the spring. On another field I will have 12 bushels per acre.

Statement of Mr. P. I. Eberrold, Clarksville, Butler County, Iowa, November, 1881.

In answer to your questions I would say the size of my farm is 297 acres, high rolling prairie, soil varying from a light sandy loam to a black mucky one, underlaid by blue or yellow clay.

I have raised spring wheat twenty-five out of the twenty-seven years that I have resided in Butler County. According to my observation the decline in yield of spring wheat in this section is owing mostly to changed climatic conditions, or more properly to adverse seasons. There are to my mind many causes that help to make wheat culture no longer profitable. I will briefly state a few of them. The hard wheats, as a general thing, have made a better showing as to yield than the soft. The straw is stiffer and stands up better than the soft varieties, and for the last few years has commanded a better price. It was but a few years ago that buyers, especially millers, objected to hard wheats. They had no appliances for grinding them properly, and as a consequence the softer varieties were more in demand. Newer processes in milling have overcome this objection. Hard wheats are in greater demand, and those who still raise wheat are rapidly changing their seed. During the first eleven years of my residence here I confined myself mostly to "Black Sea" wheat. The yield was better than the soft wheats, although, owing to the objection stated, it did not bring quite as good a price. "Canada Club" was also largely raised at that time, which, on new land, yielded from 20 to 35 bushels to the acre. The "Black Sea" would yield from 20 to 25 bushels. I have always considered the "Black Sea" as producing the best flour. It is like most hard wheats, richer in gluten, while the soft varieties consist mostly of starchy matter, making a whiter but not near as nutritious a flour. Twenty years ago there was considerable of the "Golden Straw" variety raised. It made the best average yield of any hard wheat raised here, but was likewise objected to on account of its extreme hardness, in fact was unsalable on that account. The "Arnautka," a Russian spring wheat sent out by the Department of Agriculture some years ago, yielded better than any wheat ever tried, but could not be sold here on account of its extreme hardness. Some called it "Rice Wheat." Well, it was harder than rice. Altogether, from my observations and experiment, I am satisfied that the departure from the hard to the soft was a mistake. The harder varieties have been more uniform in yield and not so subject to the many casualities to which the softer varieties are liable.

As to the causes that have brought on the decline in wheat culture and its yield, I will briefly state a few of them, premising that the weightiest of them can be attributed to a change in atmospheric conditions. What the causes of this change are I will not discuss here, although I have, like most men, my pet theories. Most of our springs have of late years been prematurely warm. The wheat plant did not have cool weather during the time that it should have to extend its fibrous roots. As a consequence the stalk shot up and formed its head before the rootlets had time to extend themselves in search of nourishment, and a partially filled head was the result.

Owing to the stalk being pushed up too rapidly by such extremely warm weather the silica that should have stiffened it was deficient, and when the extreme high temperature prevailed during or just before harvest, the straw became "cooked" and "strawbreaking" was the result. If this casualty occurred a week or more before harvest the grain was shrunken to a great extent. Blight or scab has also been a leading factor in the decline in wheat yield. Should heavy dews or rains occur during the time that the wheat is filling and a hot sun strike the head while the moisture is yet between the chaff and the immature grains they become scalded and are killed. The head is "spotted," "scabbed," or "blighted." These blighted grains will "clean out," owing to their lightness, and by that much diminish the final outcome of the crop.

Owing to these and other facts that I might state the wheat crop has ceased to be a profitable one in this country. The yield the past harvest ran all the way from 2 to 12 bushels per acre; none that I could hear of above that.

That this decline is attributable more to a change of seasons than to a loss of fertility of the soil is evidenced by the fact that six years ago we had a splendid crop, running from 18 to 28 bushels per acre, the best yields occurring on fields that had been run in wheat from twelve to fifteen years in succession, while new lands did not go above 18.

All the atmospheric conditions were then favorable. From these observations, and reflections thereon, we may conclude that wheat raising in Butler County will again come to the front when the seasons regain their normal condition.

Statement of Mr. Russell, secretary of the Dane County Agricultural Society, Madison, Wis.

The soil of this region is that of burr-oak openings and prairies; the openings being composed of clay and the prairie of dark loam. The soil is now exhausted of wheat-supplying qualities. Wheat has not averaged over 7 bushels per acre for the last ten years. Twenty-five years ago one could break new land and be sure of getting 25 to 30 bushels per acre, but now even new ground will not yield a crop. A similar experience had been had in Illinois. My theory is that the long-cultivated land draws through the atmosphere wheat-producing qualities from the new. I have noticed that in May, when the wheat is 2 or 3 inches high, the hot and dry southwest wind would do it an injury from which it would not rally. If, however, the wheat is up enough to cover the ground, it would not be injured. For the last ten years farmers have lost money trying to raise spring wheat. They do not like to give it up. They take pride in raising some wheat. Nevertheless, men who used to have their 50 or 100 acres now have 2 or 3 acres; enough so it shall not be said they do not raise any.

Ten years ago we had 160,000 to 200,000 acres in wheat in this (Dane) county. It has been constantly declining, till now only about 70,000 acres of wheat, including all sorts, are cultivated. The leading variety is "Lost Nation." Only a little hard wheat is raised. Mere wheat-growing is a very shiftless sort of farming, as it employs the farmer only a portion of the time. No system of rotation of crops has been practiced till within the past seven years or so. Within that time farmers have begun to seed down clover. The practice is to sow clover with the small grain in spring; the next year cut the first crop for hay, and, early in the fall, plow under the second. The next year manure the land and plant corn, and after that wheat, oats, clover, or rye. I think the most economical way of recuperating the soil is by this rotation with clover; also, that it is the exhaustion of the soil by continued growing of wheat, rather than atmospheric causes, which has led to the failure of wheat. The climatic changes have had no material effect.

Three years ago there was a good yield of winter wheat, but for the past two years it was a failure from being spring-killed. The chinch bugs seem to be a consequence of the poverty of the soil, as lice attack a poor half-fed calf. They migrate; and when once they get into the soil they cannot be got rid of, except by putting it in clover.

The yield of corn is 30 bushels to the acre, being below the yield that people talk about. The variety is Yellow Dent. Have known of but one failure of the corn crop in the past twenty-nine years, and that was about six years ago, when there was a frost in August.

A good many hogs are now being raised. The number in Dane County in May, 1880, was 70,000, not including sucking pigs. One-third of the number given could be added as the product of that year. Hog raisers do not generally keep many cows. The spring pigs in the fall will average 200 pounds, alive.

There are an equal number of sheep in the county. Last year the number of acres of corn in Dane County was 89,000, of oats 73,000, of barley 23,000, of rye 5,000, of potatoes 4,000, and of tame grass 51,000.

Statement of Mr. Robbins, Madison.

[Mr. Robbins is the proprietor of the only flour mill at Madison, and devotes his personal attention to the purchase of wheat for grinding and to the management of the mill. He has been there the past sixteen years, and is a witness to the decline which has taken place in the production of wheat in the vicinity of Madison. His mill is a roller mill with a capacity of 100 barrels of flour a day, which would be the same as one with three run of stones. The mill is situated at the shore of Lake Mendota, which forms the western boundary of the city, and is carried by the water which flows from that to the lake on the east side of the city. To supply the mill, Mr. Robbins pays the farmers a little more for their wheat than they could get from the shippers; and yet, although the most of the wheat is brought to the mill, he finds it difficult from these sources to get enough to keep the mill running. Mr. Robbins says:]

Hard spring wheat is no longer raised in this vicinity, unless as a very exceptional crop. The bulk of the wheat is the "Prussian," or, as frequently called, "Lost Nation," and has been grown here during the past six years. If any crop is got at all it is from that. The "Red Astrakan," the "White Michigan," and the "Rio Grande," all soft varieties, are also raised to some extent. We get along with the soft wheat with the rollers, as we do not make patent flour. The third grade of flour is exchanged with the farmers for wheat, and the second grade, or snow flake, is for city custom.

I attribute the decline in the production of wheat to the hot weather and not to the soil, because it is found that new land will not yield any better than the old. The poorest land yields the best wheat in quality, but not the most. The soil in the oak openings, though not as deep as the prairie soil, will last fully as long. As to the chinch-bug, they do not flourish in clay soil or in thin soil.

Statement of Mr. Joseph Heim, Dane County, Wisconsin.

[Mr. Heim, who is a native of Bavaria, has a farm of 120 acres, 6 miles from Madison, near the Middleton railroad station, on high rolling land with gradual slope to Lake Mendota, on which it borders. The soil of the farm is composed of clay and sand, and is valued by Mr. Heim, who still works it in person, at $50 an acre. Mr. Heim states:]

On this farm I have raised spring wheat successfully for the past thirty-two years. When I first settled upon the land it was wild and covered with very large burr-oaks.

I have had good success in wheat growing; and have given my wheat fields a rest every four or five years by raising corn and manuring the land. There has been some decline, however, in the yield. About eighteen years ago I got 20 bushels to the acre, but of late years only about 12 to 15 bushels. I have raised "Rio Grande" wheat for twenty-five years, and am not acquainted with the "Scotch Fife." My "Rio Grande' "tests" 59 or 60 pounds and sometimes 62 pounds per bushel. I would not expect to keep up profitable wheat growing if I did not change occasionally from wheat to other crops.

I get as high a price for my wheat as does any one else. I sow early, but do not harrow the land before sowing. Instead, I go over it cross ways to the furrow with a cultivator, and then put in the seed with a drill (not harrowing afterwards). After the wheat is up, I roll with a heavy roller. After harvesting, I let the wheat remain in stack five weeks before thrashing.

Never have had wheat hurt in stack, and if well stacked it can stay till spring without injury. I sometimes sow clover; let the land remain in clover two years, plow under the autumn crop of the second year, and plant corn the following year. Have tried wheat immediately after clover, but it does not do well.

My yield of corn is 55 to 60 bushels per acre.

Have not found my land suitable for oats, but have been habitually successful in raising barley. It is my practice to sow barley before sowing wheat, and to cut it two weeks before cutting wheat.

I bind it in sheaves, put it in shocks, and afterwards stack it. Think barley may be hurt by frost till it is five inches high.

Barley wants light but rich land; wheat wants heavy dry land; have raised as much as 30 bushels of winter wheat per acre, but think it liable to winter kill, and that it is too uncertain a crop; have never used salt on a wheat crop. This farm has never been troubled with chinch-bugs.

Statement of Mr. H. J. Hill, Madison.

[Mr. Hill's farm is 4 miles from the city of Madison. He has farmed here for thirty-five years, having removed from the Genesee Valley of New York State, and is still a practical working farmer. His soil is a rich loam, and has been more or less infested by chinch-bugs for several years. He says:]

Spring wheat is no longer a paying crop in this latitude. The Scotch Fife did well till about ten years ago, when the chinch-bugs came. For the past six or seven years most of the spring wheat which has been raised hereabout has consisted of the Prussian ("Lost Nation") and the "Odessa." I think the decline in wheat culture has been caused, in great part, by the continual cropping of the same land with wheat; that the same experience is being had here which was had a number of years ago in the Genesee Valley, but where now is a revival of wheat growing.

I remember to have had the best wheat crop in 1860 that I have had in any year, and think it owing to its having been sown in the month of March. Last year I put a barrel and a half of salt on 6 acres seeded with "Lost Nation" wheat, and got 18 bushels per acre. Have lately tried spring wheat on new land, and the chinch-bugs got into it and spoiled it so I did not cut the crop.

I think the chinch-bugs are more injurious on new than old land, and that they are also worse after a crop of corn than before. The "Fultz" winter wheat has been raised at the University fourteen years, with only two failures in that time. Two years ago I raised "Fultz" wheat, which yielded 32 bushels to the acre. Even though it is an uncertain crop from the danger of winter-killing, I venture to try some every year. I think wheat should be in stack three weeks to get through the sweat; never had any injured in the stack.

There is no need of its suffering any injury from wet weather if properly stacked. I feed the straw to horses mixed with a little grain.

In respect to rotation of crops, I have used clover for several years, and think it some protection against the chinch-bug. One difficulty as to the clover is that it is not liked as hay by all kinds of stock.

Corn does very well in this climate. The yield on my farm is usually 60 to 70 bushels per acre. One man with a team can tend 60 acres. I think barley may be hurt by frost if sown too early. However, I had some one spring exposed to a heavy frost without injury. Though unpleasant to handle, it is a profitable crop, the price being $1 a bushel.

Statement of Mr. Eli Stilson, Oshkosh, Winnebago County, Wisconsin.

I have raised wheat in Winnebago County, Wisconsin, thirty-three years. For twenty years, from 1859 to 1878, inclusive, made a general average of 20⅛ bushels per acre on an average of 140 acres. Soil, dark loam, with some red clay, and subsoil red clay with some lime and gravel.

Farms on which little stock is kept or clover raised, and on which no systematic rotation of crops has been followed, have steadily decreased in yield, until now, from exhaustion of the soil, they produce only half what they formerly did, while farms which have kept stock and pursued a suitable rotation of crops still maintain their wheat productions, except in extremely unfavorable seasons.

Mixed farming, in which stock, clover, corn, and wheat shall be combined in such order as is best adapted to the locality, will, in my judgment, be found the most successful and profitable for wheat culture.

Statement of Rev. W. C. Rice, Red Wing, Goodhue County, Minnesota.

I have lived in Minnesota since 1856, and have had farms in Olmsted, Goodhue, and Redwood Counties. Now have a very fine tract of land in Goodhue County, and as it has a good supply of spring water, I shall turn it from a wheat to a dairy farm. Farmers in Goodhue County will have to turn their attention to something besides wheat—say stock and grass.

There is no part of the United States now better for clover and timothy than the southeastern counties of Minnesota. They could not be grown there twenty years ago, because the wild nature of the soil has to be worked out of it before tame-grass crops will grow.

The principal difficulty with wheat-growing in Goodhue County at present is the chinch-bug. This insect came into the southeastern part of Minnesota a number of years ago, and has steadily been working its way in the State at the rate of about fifteen to twenty miles a year. They are sometimes seen in great swarms flying low down in the air, and thus moving from one locality to another. They were so seen moving into Dakota County this season. This insect, which for years has done vast damage to the wheat and corn crops of Illinois and Missouri, has been described by Professor Riley in the report of the Department of Agriculture for 1874. I have watched the habits of the insect with some care. It winters in straw stacks and between the corn leaf and stalk. Its ravages on wheat are at the tender roots. The eggs are laid on the grain just where the sprout comes out, and the young insect immediately commences at the roots. Those hatched in one season are the only ones that live over the following winter. The chinch-bug is sensitive to the approach of a person in a field, and will remain still when one passes. In removing the earth from about the roots of corn or wheat they will be found burrowing among the roots in large numbers. I think they have been produced by careless farming, and that one preventive against them is the sowing of clover with the wheat, as much, for example, as one would sow for the purpose of seeding. The clover shades the soil and tends to keep it moist—a condition which seems to be unfavorable to the insect. The clover is likewise advantageous to the soil when plowed under.

I tried salt this year on 75 acres of wheat, using 175 pounds to the acre. Have not thrashed, but those who have seen the wheat say it will yield uncommonly well.

The effect of the salt was particularly apparent in the increased stiffness and firmness of the straw. As, however, salt is a mineral which, for the most part, remains permanently in the soil, the effect of continued application remains to be seen.

In opening a new farm for wheat, the breaking should be done in June if the land is prairie. Depth depends on quality of soil. A majority of farmers break 3 inches deep. The advantage of dividing the field, in breaking, in comparatively narrow lands, consists in the saving of distance and time in going round the ends, and in leaving the dead or center furrow for drainage. On the second land one breaks around the land gradually, narrowing it, and finishes up with the dead furrow. In back setting one simply turns the furrows back, yet goes a little deeper than the breaking, usually an inch deeper.

I do not think it advantageous to plant corn on the sod (the same season as the breaking), but it is very beneficial to have stock run over it during August. If flax is sown there is not so good a crop of wheat got the following season. It is settled that it is not best to have any crop before wheat.

In spring, as soon as the ground is ready to work, harrow. One cannot harrow too much. The cultivator-tooth harrow is quite serviceable, so also the revolving harrow. You get an idea of the latter by placing a wagon wheel flat on the ground. The revolving harrow goes over the sod diagonally (obliquely) and directly at the same time. It clears itself effectually of any rubbish. These harrows are manufactured at several places, and there are various sorts costing all the way from $15 to $40 each. A good cultivator-tooth harrow costs from $30 to $35. There are 72 steel teeth in each sort. On old land the $15 harrow will do excellent work. On new land the cultivator-tooth harrow does the best work, and is the cheapest in the end. One man with one pair of horses could harrow 15 acres in a day and leave it in good shape. This, however, would be going over sod only once.

A seeder will seed 10 acres a day. Opinion is about equally divided as to broadcasters and drills. I think on older land infested by chinch-bugs it would be necessary to use the drill, which covers the seed from 1½ to 2 inches, and puts the roots below where the bugs ordinarily work.

The seed should be as clean as possible. The ordinary fanning mill usually has attachments which thoroughly clean the wheat. A good fanning mill with cockle attachments costs from $18 to $25. Two men with such a machine will clean all the way from 150 to 300 or 400 bushels in a day, according to the convenience of handling, and whether the wheat is in sacks or otherwise. Those who use seeders have to clean their seed with the fanning mill. In Goodhue County, farmers usually clean their seed; it will not pay a farmer, however, to take such pains in cleaning wheat for the market. All the best thrashing-machines now clean wheat sufficiently for the market. Still, if the wheat is not heavy enough to go No. 1 without cleaning, it will pay the farmer then to clean it for the market. He should sow only one kind of seed, so that it will ripen equally. Buyers are apt to grade wheat lower if it is mixed. The reputation of Minnesota flour depends on raising hard wheat—"Scotch Fife"—which is the best variety we have. On the frontier, since the grasshopper plague, wheat is much mixed, owing to the fact that it was taken from elevators on the Northern Pacific Railroad.

I think rolling of the ground is beneficial in Southern Minnesota. It must depend on the judgment of the farmer; but the rolling should not be done till the wheat is three to five inches high. I rolled my wheat the 5th to the 7th of June, when it was 7 or 8 inches high, and found it beneficial. It is not the usual practice to roll. If the ground is wet it would not do to roll. Rolling will be a check against chinch-bugs to prevent their working in the ground. They do not bore into the soil, but find their way through the crevices.

I would not apply salt till the grain is up and 5 or 6 inches high. This is the fourth year I have sowed salt. Its use now on all of the best farms in Southern Minnesota is quite common. A dealer at Rochester, Minn., sold this season 2,000 tons of salt; 150 tons were sold at Zumbrota, Goodhue County. The uniform practice has been to sow salt after the grain is up. The only action beneficial to vegetation is that it attracts moisture and holds it. The straw will take up certain elements of salt. I got the idea from my father, who was brought up near salt works, and near where salt was used on land. Seven or eight farmers in Olmsted County last fall spoke highly of using salt. I do not think it is now needed on new soil. In wearing out wheat soil the element that furnishes straw fails first. The salt which is used is called agricultural salt, and is a refuse salt, not valuable as a commercial article. It was furnished in this part of the State (Goodhue County) at about $7 a ton at warehouses, making it cost, say, 40 cents an acre, at 150 pounds to the acre. It is a crushed salt of white color. The way of spreading it on the ground is to drive through a field at a walk, one man driving, and another man scattering the salt with both hands over a breadth of 20 to 25 feet. Thirty acres can thus be spread with salt in a day.

One can send to Canada and get pure "Scotch Fife." Last year I got pure "Scotch Fife" and raised 18 bushels of No. 1 wheat per acre, while I got only an average of 13 bushels per acre, on another farm, of our home variety.

There is an advantage in changing seed from prairie land to timber land, and from timber land to prairie land; so also in changing from sandy land to dry land, and *vice versa.*

Have found from experiment that wheat left in stack over winter will not, when sown, produce a crop. I attribute the general failure this season partly to that—the winter last year having set in the middle of October, and taken farmers by surprise. Others have found that only three grains in ten of seed that had remained in stack over winter would grow. My theory is that wheat always undergoes sweating in stack, and that when it has been thrashed and put in the bin it will sweat again. The bran is so thick if it has not been through the sweat that the germ cannot penetrate. Sweating thins the bran.

Am unable to say whether seed does better when brought from the South to the North than when brought from the North to the South. Only know that a few years ago when the crop failed and farmers got seed from farms along the Northern Pacific Railroad it did not succeed. But seed from Canada does well. Have known seed from Illinois to do well here. Every farmer ought to select the best wheat of his field for seed, and do so every year, and keep it separate. In every field there will always be a portion or portions that will be better than the rest, and the wheat from these should be culled out and kept for seed.

It pays every farmer to stack his wheat. Labor is higher just at the close of harvest than it is three weeks later. It takes more force to thrash from the shock than from the stack. Wheat looks better and weighs better. Very few farmers here thrash from the shock.

One trouble with farmers is that they do not begin soon enough to harvest their wheat. It should be cut just as soon as it has reached that condition when the kernels will not stick if pinched between the fingers. Its color in the field then will be a golden yellow. If it stands longer it will be a white yellow. The practice now almost altogether is to use the twine self-binder. I consider it the best. It is also the cheapest. Two men with a self-binder will put into shock as much wheat as seven men would do after an old-fashioned reaper. Two men with one machine can cut and put in shock 10 acres a day. Ordinarily, with good weather, wheat can be stacked in four days after being in shock. There is great risk in wheat standing in the field. A great deal of wheat is spoiled in the stacks, from the latter having been improperly made. In stacking one should keep the middle so that the outside sheaves slant downward. We are apt in this State to have heavy falls of rain, which makes it the more important that stacks be made large.

With good weather wheat will have gone through the sweating process in three or four weeks, and one can go to thrashing. When the sweating is occurring the straw is damp and hinders the work of thrashing.

The steam thrashing-machine is the one now in vogue—the one that uses straw for fuel. Such a machine will thrash from 600 to 900 bushels a day. The thrashing costs the farmer about 9 cents a bushel, including all labor except that of taking the wheat to the barn or store-room after thrashing. The machine costs $1,700 or $1,800. The proprietor of the machine boards the hands that do the work.

Wheat ought to be stored in a detached building. The best use to put straw, if it cannot be used in the barn-yard, is to draw it off, scatter it about, and burn it. As a matter of course, the farmer will build his stacks on the poorest part of the field.

The remedy against deteriorating soil and crops in this part of the State is the use of red clover. I would in such case raise it as a grass crop.

In June, 1880, a farmer of this county plowed under 100 acres of red clover that was 3 feet high, and raised a remarkably good crop of wheat on the land this year. The land had been cropped fifteen to twenty years. Thinks his crop of wheat will be 20 bushels to the acre.

A successful *rotation*, including wheat, can be practiced with corn, oats, and barley. It will not do to summer-fallow in Minnesota. Farmers have tried it and find that it loosens the soil too much. They now plant corn instead. It does not pay to raise clover to sell as hay. There is not stock enough now. We shall raise more wheat to the acre hereafter, but not so many acres.

No trouble is experienced here in regard to the labor question. Excepting in ten days' work in shocking and stacking, and three or four days in thrashing, the labor of two men, with suitable implements and teams, will take care of a farm of 160 acres, and do it well. It would not be necessary to have the second man the entire year, but only for the season, from April to November. A good man could be had for such period at from $20 to $22 per month, with board, lodging, and washing. Such a farm (of 160 acres) requires five horses. Three horses are required on the sulky plow. With such a force a farm could be cultivated as follows: 80 acres in wheat; 20 in barley; 20 in oats; 20 in corn; 20 in grass; total, 160 acres.

Such a farm of first-rate soil, properly worked, will yield, on an average, a net income of $600 to $700 a year. If the farmer labors himself, his wages should be added to such income.

My farm of 160 acres paid me last year $890, besides the seed for the year, in all say $1,000 as my share; but of that sum, however, should be deducted taxes, wear and tear of machinery, seed, and interest on capital, say $250, which will leave $750 profit.

This year I will do better. There were made last year on my farm 600 wagon loads of manure, which I use on corn land.

Statement of Mr. Francis Davis, Goodhue County, September 16, 1881.

I have been farming in Minnesota twelve years. I have been following the exhausting system of raising wheat which has prevailed in Minnesota, sowing wheat after wheat. This system of farming is so well known in this State as to need no description. It is my purpose to change my system and raise a variety of crops, recuperating my land by stock.

Our soil is that of a high rolling prairie and clay loam. We plow as early as possible after harvest, turning the furrow from 5 to 7 inches deep. We harrow twice, once just before and once after sowing; we sow with a drill and use a Scotch harrow.

We use the "Fife" wheat, taking great pains to secure the best seed. I have three times, in twelve years, gone to Canada to renew my seed. We sow from a bushel and a quarter to a bushel and a half per acre, as early in the spring as the ground can be worked. Rolling is desirable after seeding and harrowing. I always roll all I can.

Wheat should be harvested at the earliest moment that it is fit—as soon as it is in the "dough." Use self-binding harvester.

There is no question as to how soon to stack in this climate. Stack as quickly as possible after the crop has been cut and shocked. We put from 100 to 150 in a stack. In a month after stacking the grain is sufficiently sweated for thrashing. Six weeks are better, then thrash any time the weather favors. We formerly considered 25 bushels a good crop. Our land is becoming exhausted. I have not yet thrashed, but have an idea my crop this year will yield about 17 bushels to the acre.

We use no salt. The best use we have made of straw has been to burn it.

We put corn on land from which a crop of nothing else could reasonably be expected. We seed with a one-horse corn-planter and a two-horse cultivator, working the corn twice each way. We husk the corn without cutting. Forty bushels is considered a good crop. Either wheat or anything else does well after corn.

After a careful study of the subject, I have adopted the following course as the best one for keeping up the productiveness of soil, and securing the largest possible revenue from the land. I adopt what is called a "five-shift course." Our farms are usually 160 acres each. Five crops of 30 acres each will occupy 150 acres, leaving 10 for garden, lawn, out-houses, &c. These crops should be: 1, corn; 2, barley; 3, wheat; 4, meadow; 5, pasture.

Each field of 30 acres should be occupied by these crops in the order named. Wheat should be seeded down with clover and timothy, 3 pounds of clover seed and 6 of timothy to the acre. The meadow should be mown the first year, pastured the second, planted with corn the third, breaking the sod as early in the season of the second summer as possible to give it time to rot. It should not be plowed again, but worked up with the harrow and cultivator before planting the corn.

For this plan of farming, as far as possible, help should be employed by the year; a man and a boy for a year, and another man for seven months. These would do all the farm work except the thrashing. A house-maid would also be required to care for the dairy. The wages of the help may be estimated as follows:

Man and boy for one year	$400
Man for seven months	140
House-maid for one year	200
Total labor for one year	$740

Besides help, the following estimate of expenses should be added to the above:

Expenses for thrashing	$100 00
Seed wheat	40 00
Seed barley	42 00
Bushel and a half clover seed	7 50
Four bushels timothy	12 00
Three tons plaster to sow on meadow and pasture	30 00
Groceries, blacksmithing, and incidentals	250 00
Total expenses	$1,221 50

Besides these expenses something should be added for replenishing the machinery, and keeping up the full number of horses. As there is some difficulty in estimating this, owing to the difference in men in the care of machinery, we will leave this out for the present.

The receipts of the farm may be estimated as follows (the price of the products is based upon the market in our county for the past twelve years):

30 acres wheat, 20 bushels to acre, at $1 per bushel	$600
30 acres barley, 35 bushels to acre, at 70 cents per bushel	735
20 cows yielding $40 each	800
40 hogs, each 200 pounds dressed, at 5 cents per pound	400
Total receipts	$2,535
Expenses	1,221
Profits	$1,314

These estimates of receipts are placed at a low and safe figure; and under proper management are realizable by ordinarily good farming. They should even be exceeded. These estimates are placed sufficiently low to furnish also pork, grain, and dairy produce for family use. By the above showing the labor is all employed. But the owners of 160-acre farms are usually practical farmers themselves, and the wages of the farmer himself, and those of his family, may be deducted from the expenses, making a difference of several hundred dollars in the profits; in many cases covering the whole of the estimated expense of $740.

The above estimate is made for cows in preference to beef cattle or sheep for stock. A comparison of the profits of keeping cows with that of keeping any other stock, can be shown to be in favor of dairy stock. Thus, 6 head of fatted cattle annually would require a standing stock of 30 head by turning them off when three years old, viz.: 6 cows, 6 calves, 6 one year old, 6 two, and 6 three. Reckoning each beef at $75, the receipts for them will be $450. The 6 cows might yield $100 for butter. This is less than the estimate, per cow, made above, because there the dairy is a specialty, and can be made for that reason more profitable. There would also be some hogs, but the dairy being less would limit their number. The total yield may be put at $600. Compare the dairy now with sheep; we estimate 1 cow as consuming what would keep 6 sheep. This allows the farmer to keep 120 sheep, but estimating that they can be most profitably marketed at two years old, he can sell but 60 sheep a year. Long-wool sheep, if fine stock, would yield $8 apiece in the spring, or $480. He would shear 120 sheep, which at 6 pounds per head, at 25 cents per pound, yields $180. This makes $660 of receipts. Thirty acres of corn would not all be needed for the sheep, and the farmer could keep a very few cows and hogs. From this there would be a slight revenue.

The figures shown above as to the profits of general farming in Minnesota are also of interest as proving the real value of our land as an investment for money. If the profits of 160 acres are found to be $1,200 per annum, this sum is the interest of a principal of $12,000, at 10 per cent. This would show our land to be worth $75 per acre, assuming that money is worth 10 per cent., which it is not, but improved land can now be purchased in Goodhue County for $30 per acre.

Compare these figures with the profits yielded by the lands of the old countries. If land in England yielded in former years an interest of 3 per cent. it was considered a good investment. But this 3 per cent. was the landlord's profit. What then must have been the profits for the tenant upon such a basis? But the present state of England is vastly inferior to this showing. This is the reason why rents often cannot be paid at all in that country now, while by the same showing the profits of farming to the owner here are such as few channels of trade in all the world afford. This also illustrates the difference that there is in the profits yielded by the land to the laborer himself in the old countries of Europe as compared with those of Minnesota. The laborer in England must work for a tenant so poor he cannot pay rent, while the tenant must make a living both for himself and the owner of the land who is still behind him, and has to be supported. So the tiller of the soil is working at a third remove from the direct profits of the soil. Contrast this with the tiller of the soil in our State, who often is laborer, tenant, and landlord, all in one, and draws the profits of all.

Statement of Mr. Perkins, Red Wing, August 16, 1881.

The principal drawback to wheat raising in this part of the State is the chinch-bug, though we never before in this county have had them bad until this year. An open and wet winter would kill them out.

Again, the wheat qualities of the soil have been taken out of it to a great extent. I have been farming for the past twenty-five years. For the past fifteen years I have usually put down 20 or 30 acres in clover and timothy every year. If the clover should winter-kill, the grass (timothy) will be good. I use 1 bushel of clover and 1 bushel of timothy to 12 acres; mix with wheat if the sowing is by a broadcaster, and use the drill attachments if the wheat is drilled. I prefer a drill to a broadcaster. The chinch bugs do not affect wheat near as much if drilled as they do when the wheat is put in by the broad-caster. The following year I cut the first growth of grass for hay and cut the second crop (the same year) for seed. The yield per acre for seed is 3 to 8 bushels. Clover seed is often worth $6 or $8 per bushel. This season clover is worth $6 a bushel and timothy seed is worth $3 a bushel. I have raised in this county as high as nine bushels of timothy seed to the acre, and sold it at $5.30 a bushel, which would be an uncommon yield. Usually instead of taking off the second crop for seed I plow it under as a fertilizer. If clover is to be plowed under it should be plowed under green. I think it preferable to plow during the last week of June, after taking off the first hay crop. This year we cut clover the 23d of June.

My soil consists of black loam with clay subsoil. I have not found it beneficial to the wheat crop to raise wheat the next year after plowing under a green crop of clover; but barley or corn does splendidly. For corn I select the lightest land, say about 20 acres, and put on it all the manure of the live stock—say 50 head of cattle and horses and 50 to 100 sheep—and the manure of sheep is very rich, and of hogs, which is better than that of cattle. The yield of corn is 25 to 50 bushels to the acre. I usually plant small "Dent." After one crop of corn I sow with barley (without manure), and get 25 to 35 bushels to the acre, and the next year sow wheat. I generally seed down with oats, because I put oats on lighter ground with a view to having it broken. My practice has been, and is, to sow wheat three years on the same field. As often as every five years, I want the ground in grass. The smallest yield of wheat I have ever had is 14 bushels to the acre, and until three years ago I never had less than 20 bushels to the acre, and have raised as high as 35 bushels to the acre.

The best plan in regard to seed is to send to Canada for seed wheat—the "Scotch Fife." The farmers there are careful, and their wheat is pure. We have found that wheat changed from sandy to clay soil improves, and the same when changed from clay to sandy soil.

In breaking new land I should break to a depth of 2½ inches. There are three or four good kinds of plows.

Statement of Mr. A. Colquhoun, Steele County, Minnesota.

[Mr. A. Colquhoun, of Blooming Prairie, Steele County, has a farm of 640 acres, of which 150 acres are under cultivation, 120 acres in pasture, and the balance in grass or wood. The soil is a dark sandy loam, resting on hard gray clay, about 9 feet in depth, and under that blue clay. He says:]

I have been farming continuously since 1866, and during the first years used to raise 25 bushels of wheat to the acre, the highest yield being 29 bushels per acre. I raise only "Scotch Fife." My yield in 1877 was 25 bushels per acre. That was the year the grasshoppers left. However, they did not trouble my neighborhood; they came only as far as the railroad. Since 1877 the average yield has been about 10 bushels to the acre; some have raised as low as 4 bushels, and some as high as 18 bushels; there have been no bugs to hurt, and I think the main cause has been too much rain in July, in conjunction with hot weather, while the wheat is in the milk; wheat does not do well on low land; it produces best on high land, and on land which has had a change of crops; a good rotation is corn followed by oats and then wheat; it is good for the land, also, to be in timothy and clover two years; wheat does well immediately after. Timothy and clover are cultivated very successfully in our county.

Statement of Mr. C. S. Kneeland, Mantorville, Dodge County, Minnesota.

[Mr. Kneeland came to Rock County, Wisconsin, in 1843, and has since been acquainted with wheat growing in this State and in Minnesota. Since 1864 he has been occupied in farming and milling, and says:]

The failure in the wheat crop the past few years is owing partly to the hot weather and partly to bad farming. Good farmers do not raise any No. 3 wheat; they raise No. 2, and generally of the hard variety. We have had no No. 1 in Dodge County for the past three or four years. I consider the "Lost Nation" of very little value for flour. The Minneapolis millers pay ten cents more a bushel for hard than for soft wheat.

Undoubtedly a rotation of crops and good systematic farming will do much to restore the yield of wheat.

Statement of Dr. T. T. Mann, of Saint Paul.

[Dr. Mann, a gentleman of scientific and literary culture, who was engaged in growing wheat at Cottage Grove, Washington County, Minnesota, from 1861 to 1871, thinks the decline in the yield of wheat is to be attributed to the exhaustion of silica in the soil, and that the most practical way to recuperate the soil is to seed it with grass and practice a rotation of crops. His farm at Cottage Grove had the common loam soil of average fertility, and he found that after three years cultivation of wheat the yield diminished to from 12 to 15 bushels per acre. During one of the first years his yield was 39 bushels per acre. He took pains in the selection of the seed, frequently changing it, which he believed to be a good plan, though adhering to the same variety, namely, "Scotch Fife." When he began, however, the "Canada Club" was in pretty common use. His yield never went below 12 bushels to the acre. Dr. Mann says:]

The true theory is this: The soil should rest every three or four years with grass. I used a drill to put in the seed so that it should be well covered. I also used a harrow that was about a third heavier than those in common use. In my observations among farmers I found that those who farmed the cheapest were the least thrifty. A portion of the Cottage Grove farmers did not spare expense in putting in their crops thoroughly, and every one of that class succeeded and prospered admirably. I lay great stress on the quality of the seed. Seed which has been heated and is imperfect will germinate and make a green field in the spring, but will not yield a crop. As to harvesting, I was forced, for want of early experience, to rely on my own investigations as to the time to cut the wheat. I could learn nothing definite from my neighboring farmers, as every one had his own notions in regard to the matter. The conclusion I finally came to, from reading and observation, was that when the heads of the grain presented an orange tinge it was fit to cut, and yielded a plumper berry and better weight than it would if allowed to stand longer. The dough was beginning to harden, though the stalks were somewhat green.

Statement of Mr. Andrew Peterson, of Woodbury, Washington County.

[Mr. Andrew Peterson, of Woodbury, Washington County, a native of Sweden, has been engaged in farming and wheat-growing for several years. His statement, dated November, 1881, is as follows:]

I sowed 94 acres of wheat in 1881 on section 13, Woodbury Township, Washington County, "White Fife" and "Scotch Fife" wheat being used for seed. The total yield was 1,550 bushels, being an average of about 16 bushels per acre. The maximum yield was 22 bushels, the minimum 11½ bushels per acre. The maximum is attributable to high culture on land that had been in clover two years, plowed in July and replowed in October. The minimum is attributable to old land that had been plowed late and sowed late.

On old land soft wheat will produce from 3 to 5 bushels more per acre than hard wheat; but on new land or highly cultivated land the hard wheat is, in our section, preferable. The soft varieties used in our county are "Lost Nation," "Blue stem," "White Russian," the latter having the preference.

The township will average about 14 bushels per acre, of which 10 per cent. is damaged by rain.

I do not believe that profitable wheat-growing can be maintained for a series of years on the same land without suitable cultivation to keep up or improve the fertility of the soil. With more care in farming the average yield of spring wheat could be largely increased.

Statement of Mr. T. T. Smith, Saint Paul, July 28, 1881.

[Mr. Smith has a farm which he occupies in Dakota County, 3 miles from Saint Paul, and which, under his personal direction, is cultivated in a skillful manner. His farm was described, together with that of Mr. Dearing in the same neighborhood, by the special correspondents of the London Times in a letter to that journal a year or two ago. Mr. Smith expressed the following views in relation to wheat culture and farming generally:]

The soil of this farm is not uniform, but varies from 1 to 2 feet of brownish loam, with a subsoil of clay and stones. Some part of the farm has been cultivated for many years. In 1864 I plowed as late in the season as November 27. One man will plow 1½ acres a day on short fields, on longer land 2¼ acres, beginning at 7 in the morning and quitting at 6 in the evening, with one hour rest at noon. I plow a depth of 5 or 6 inches. Now use a plow from the Saint Paul Works. Sometimes the plowing goes over till spring. In the spring, if the field is quite smooth, I sow the wheat without harrowing. If the ground, however, is rough I harrow it, using a spring-tooth harrow, until the land is in good condition. The harrowing is usually done in April. During a series of several years I have sowed wheat from the 14th to the 25th of April, which I know from having noted the dates in a diary. I sow with a broad-caster, and use 1 bushel to 1¼ bushels of seed per acre. It is the custom of a number of the best farmers of my acquaintance to practice light seeding. The broad-caster covers the seed, but I harrow it in besides, letting the harrow lap so that it amounts to double harrowing. The seed should be covered from ½ to 1½ inches with the earth. One man with broad-caster will sow about 10 acres a day.

Have only cleansed the seed by sifting. Twenty years ago the "Canada Club" was in use. The second year I used it the yield was 8 bushels to the acre. I discontinued it on account of "smut." After that I got the "Scotch Fife," which I have used ever since. Previously, however, I had used the "Odessa" (a soft wheat with small kernel). It yielded better than the other, but had a weak straw, and lodged and rusted badly. One season I raised 32 bushels per acre of winter wheat. The next year it winter-killed.

A trouble with wheat in this vicinity is its being badly mixed. A number of varieties are found in the same field. The "Scotch Fife" matures about the last of July. On light, elevated land wheat will be ripe while on heavy ground it is still green.

This year I purchased a Wood self-binder (it now costs $315, with 15 per cent. off for cash, Mr. Smith thinks). It cuts and binds one acre per hour, with two men besides the driver. About 12 sheaves are put in a shock. The shocks are usually left until the cutting is done. Then stack.

Wheat will go through the sweating process either in the stack or bin, and it is better, millers say, that it go through the sweating in the stack. This sweating in the stack requires three or four weeks. If thrashed before this process, it will not all get thrashed out.

On a large farm it is economical to thrash wheat in the field without stacking, as it saves the labor of stacking.

My average yield has been 14 to 28 bushels per acre. In an old field that had been under cultivation twenty years the yield was only 10 bushels per acre. There have been only two years when my yield has been less than 20 bushels per acre.

My wheat fields have generally been in Indian corn or potato crops before sowing with wheat. Use all the manure made at the place on the corn crop. One winter I brought wood and coal ashes from Saint Paul and put on grass land, but it did not appear to have any effect. Think the application was perhaps too early in the season.

Wages are about $20 a month and board. Harvest wages about $2 a day.

It is generally considered that it costs $10 an acre to put in and take off a wheat crop, including interest on capital. The wheat crop is generally overestimated. Would be a great benefit to farmers if the returns of the assessors could be published same summer they are made. It would prevent wheat gambling.

The principal danger to the wheat crop in this vicinity is storms; also dry, hot weather gives wheat a premature ripeness. The last ten days of the crop are the most critical. To maintain profitable wheat-growing there must be a change of crops. The continuous growing of wheat on the same land for many years cannot be considered profitable farming.

Two men can take care of 80 acres of wheat—perhaps 100. The 80 acres would give about 1,600 bushels about here, but that yield could not be got on lighter soil.

I think the railroad tariffs are high.

Statement of Mr. W. B. Quinn, Ramsey County, Minnesota.

I have raised wheat in Ramsey County the last twenty-seven years. My present farm is situated about 3 miles from the city of Saint Paul.

I have noticed a decline in the yield of wheat in this State for the last three or four years, even on newly broken land, which I attribute to the hot weather at the time of ripening. There has also been a decline in the yield on old land, which can be attributed to the recurrence of wheat on the same fields for several years. The means I would recommend to increase the yield on old land is to sow the land with clover and adopt a system of rotation. One reason why I would recommend clover is, the roots are long and perforate the soil. It is also impossible to get a sufficient quantity of manure to replenish the soil. Near the large towns the gardeners get all the manure. Besides, farmers have not time to draw it.

The millers do not pay enough more for hard wheat to make it a sufficient object to raise it when the soft wheat will yield more, which is sometimes the case, but not always. The practice of mixing soft, and sometimes even damaged, wheat with sound hard wheat at the elevators works a hardship to the growers of hard wheat.

My soil is on burr-oak openings, of black sandy loam and light yellow clay subsoil mixed with sand, resting on gravel at a depth of 5 or 6 feet. My present farm has been under cultivation twelve years. The only kind of wheat I have raised there for a crop is "Scotch Fife" pure. My method is to plow as early as I can after the harvest, in August and September when I can, and at a depth of 8 inches, which I call deep plowing. My neighbors plow 4 or 5 inches deep. The advantage of plowing early is that the green vegetation can be decomposed; also, it has not gone to seed at that time of year. If plowed later the seed of weeds would be matured. In this way the land is kept clean. Land should not be plowed when it is wet enough to pack. The only objection to plowing land when it is too dry is that it is more difficult to do. It wears more on the plow, and it is more difficult to get a good depth. With ordinary walking plow 2 acres a day is good work.

The next work is to harrow the ground in the spring; some harrow and some do not, but it is best to harrow; once harrowing is sufficient. I prefer to put the seed in with a drill; sow as soon as possible in the spring—just as soon as the frost is out of the ground enough. By sowing early you get less straw and a better ear; late sowing would give more straw and less ear. By sowing early it has more time for growing. I cross-harrow after the drill, and roll then or after the wheat is up; I prefer rolling immediately after sowing. There is a great diversity about the quantity of seed to sow, but I never use more than a bushel per acre. The seed I put through the fanning-mill; it must be clean. I have found that wheat will yield as many bushels per acre as the heads will average berries. The harrow I use has 72 teeth, and is drawn by two horses. It will harrow 12 to 15 acres a day well. It is 12 feet wide.

The wheat should be harvested just as it is entering the dough state. Beginning even then the last of the crop will be very ripe. The heads have a sort of golden color, and the stalks have yet a green shade when you begin to cut. The first cut is always the heaviest and best. The hull is thinner and the berry has a brighter color. The self-twine-binders now take the lead in harvesting. It requires two men to follow a self-binder to shock. Three or four horses are enough to draw the binder. On some farms two horses would do. This season the wages of harvest hands were $2.50 a day and board and lodging. I prefer a round shock capped. The wheat can be stacked in five days after cutting, in ordinary dry weather. It is impracticable to thrash from the shock on account of lack of help. The grain could not be thrashed so easily from the shock. The better plan is to stack it in stacks with 50 to 75 bushels in a stack. Usually the diameter at the bottom is 12 feet, at the bulge it ought to be 20 feet, and tapered so as to shed the rain. Keep the center full. Below the bulge have the longer straws of the sheaf uppermost. When you get to the bulge reverse and put the sides with long straws down. In beginning a stack we set the sheaves on end for the base. It should remain in stack four weeks. The sweating will then be done. When wheat is in the sweat it is slightly warm, and it is almost impossible to thrash it clean. When it is through the sweat it is ready for thrashing. If wheat is well stacked it will not be injured by the weather. The testimony of thrashers is that a great deal of wheat is improperly stacked.

Thrashers charge now 4 cents a bushel for wheat and 2 cents a bushel for oats. The farmer finds the coal for the engine, and all the manual labor except the fireman, the feeders, and the engineer. Horse-power is no longer used in this vicinity in thrashing.

I have never raised less than 17 bushels of wheat to the acre. For the first six consecutive years on my present farm I averaged 33 bushels per acre. One season I had 40 bushels per acre. Have experimented with salt on wheat when it was 4 inches high without success.

My land was originally partly covered with burr-oaks and is a clayey loam.

My system of rotation has been corn, then wheat, followed by grass or corn. I plant corn as early as I can; put on what manure I have, and average 50 bushels of shelled corn to the acre of "Yellow Dent." Cultivate with cultivator twice each way, beginning when it has been up a week, and then with double-shovel plow once a week four times with one horse, so as to keep down the weeds and the land loose. Here we cut the corn and use the stalks for fodder. My plan is to sow wheat on the corn land without plowing, provided the land is kept clean. The wheat is better than if the land were plowed. It is harrowed in the spring once, and then the wheat is put in with a drill, cross-harrowed once and then rolled. For corn the land has been plowed say the present August; but it will answer to plow it in the spring. Generally harrow. There are less weeds when the plowing is in the fall. My practice is to put the manure on and spread it before plowing. It requiries ninety-five days for wheat to mature. Whatever time sown it must mature about the same time. If sown late there is more straw.

Corn matures here in four months.

We sell our wheat straw for stable bedding in the city at $3 to $4 a ton; the paper mill pays the same.

It is not prudent to raise wheat on the same soil more than two years in succession. To sow one year is better. I keep my land in grass three years; clover and timothy three years. The last year take off one crop of hay and plow under the second growth. Let wheat follow clover; that has always been successful with me. If I had manure I would put it on those parts of the grass which needed it. Timothy and clover are extensively cultivated in this vicinity. The older the fields become the better they retain the grass. For oats or barley the treatment of the soil is the same as for wheat. Some prefer to sow oats first, so as to cut them before the wheat is ready. My yield of oats is 40 bushels per acre. Do not manure for oats; would rather have oats follow wheat than precede it. I sow 2 to 2½ bushels of oats to the acre, and with the seeder, just the same as wheat; also, cut, bind, and stack the same. It is preferable that they go through the sweat. Oats are the most exhaustive crop we have.

My average crop of barley is 35 bushels; have raised as high as 50 bushels. We sow two bushels of barley to the acre. It needs a good rich soil, but exhausts the soil less than oats. Frost has never affected mine. In harvesting, stack it as soon as it is dry. Let it cure a day or a day and a half; we do not bind it, but stack it loose. Thrashers charge 3 or four cents a bushel. Grass would be the best to follow oats; but oats are not the best to insure a catch of the grass. Barley is better because it ripens earlier, and is out of the way first, and gives the grass a chance to start. It ripens about the 10th of July, and is the first grain crop, being cut two weeks before wheat. The beardless barley is of no account here.

Flax would not do harm to land as a first crop on the sod. It is an exhaustive crop. I tried it once and it fell down, because my soil was too rich.

There is some complaint of the chinch-bugs in this county.

An average 160-acre farm would have 100 acres for cultivation. For such a farm there should be two hands all the summer season; two teams of two horses each. The hired man's wages would be $20 per month. The amount of stock depends on the quantity of small grain and grass raised.

Ten bushels of corn will make 100 pounds of pork. If corn is 50 cents a bushel it makes the pork $5 a hundred without counting the labor.

One man could not cultivate 50 acres alone in general crops. He could cultivate, however, 50 to 80 acres of small grain alone, but it would be difficult, and he would have to work very hard. Two men can work to better advantage.

It is more profitable to fatten spring pigs than to winter them over and then fatten them. An April pig can be made to weigh in seven months 300 pounds. The best breed is a cross between the Poland-China and Berkshire. The latter alone is a little too small. I feed my hogs raw corn, meal, &c.; if cooked it would make them fatten better. They want water if there is no milk, and it is better if there is a dairy. A clover-field makes the best pasture for a hog; timothy is not good. Kentucky blue grass is common around here, and is useful among other things for killing out weeds.

The implements for 100 acres in cultivation would be:

One sulky-plow, or 2 walking-plows	$45 00
One harrow 12 feet, 74 teeth	14 00
One drill, first rate	80 00
One cultivator, 5 shovels	8 00
One double-shovel plow, for corn	8 00
One mower, for grass	70 00
One self-binder	280 00
Two wagons @ $70	140 00
Four horses	600 00
Four sets harness	60 00
Total cost	$1,305 00

Working men on a farm rise at five o'clock in the morning the year round, and do the chores as the first work. Breakfast at six or six and-a-half; one hour for dinner, from 12 to 1 p. m. They quit work in the field at 6.30 p. m., and eat supper at 7 p. m., in the summer time. They assist in the milking, and if there are many cows they would leave the field earlier than 6.30 o'clock. Some people work until dark, but, as a rule, the number of hours of actual labor is ten to eleven even in harvest.

Statement of Prof. E. D. Porter, superintendent of the State Agricultural College of Minnesota.

Professor Porter was formerly professor at the Agricultural College of Delaware, and in a conversation with him, August 12, the following information and opinions were communicated to me by him. He had recently made a tour among the wheat-fields of Dakota and Minnesota, and to illustrate the different kinds of farming mentioned the case of a farmer in Renville County, who will get 18 bushels to the acre from having harrowed his fields repeatedly, while surrounding fields cultivated in the usual way will produce only 10 bushels to the acre. The neighbors told the successful farmer in question he was taking needless trouble, as the yield would be just as much with the ordinary cultivation.

Professor Porter has given special attention to wheat culture. He attended during the last week in June and first week in July a conference at Lansing, Mich., to agree on a co-operative system of agricultural experimentation at agricultural colleges. A committee was appointed to select subjects of experimentation, and at his suggestion wheat was adopted as one of the subjects.

Professor Porter, a few years ago, imported varieties of wheat from different countries, and undertook a series of experiments in hybridizing to secure improved varieties. The results were not satisfactory, as he found the new varieties to be too sensitive to rust, or other evils to which wheat is liable. At my request he entered into an explanation of the way to propagate new varieties, and with the aid of his microscope explained it clearly. Every simple flower of a plant has both sexes, if, as is usual, it is perfect. The female of the flower is but a single stem, while there may be several male organs. The fecundation takes place while the plant is in flower. To secure a new variety of wheat, the plant that is intended to give birth to the new sort will be treated as the female. To prevent impregnation of its own variety the male organs of the flower must be removed. They should be clipped just as soon as in bloom, then the dust (pollen) or invisible particles adhering to the male organs of the other variety of wheat are brought and brushed over the flower to be impregnated. It is just as easy to distinguish sexes in the wheat-flower as in any other. The plants intended for producing the hybrid should be kept within doors, removed from any other plants and from each other. In hybridizing or creating new varieties the object would naturally be to give to one variety some lacking quality; for example, you have a sort of wheat excellent in the grain, but feeble in the straw; you would then seek to unite it with a sort that has a robust straw.

It is not expected that farmers will often undertake experiments of this sort, and yet it is but proper they should have an idea of the laws of nature by which new varieties are produced. In breaking the prairie soil he would break to a depth of only two or three inches, because the sod consists of roots which would not rot during the summer if the turned sod had a greater depth, especially in wet weather. In the autumn he would back-set a depth of two inches more, and in the spring, just as soon as the frost is out of the ground, a depth of four inches; he would then begin to harrow and continue the harrowing until the soil was thoroughly pulverized. Important improvements can be made in the present harrows. He thinks favorably of the Le Dow disk harrow. It has a set of disks, say like a set of dinner plates, about 10 inches apart. The disk rolls, concave on one side and convex on the other, are made of steel and are sharp. They cut the soil obliquely, making a sort of furrow.

There should be successive harrowings to get the soil so fine that it will cover all of the seed. Generally much of the seed after being sown is not covered.

Here (in the Northwest) he would put the seed in with a broad-caster seeder; but after he had cultivated the ground three years or so he would expect it to be so tilled that a drill could be used in putting in the seed; the advantage of which method is it covers the seed. A seeder sows a width of about 8 feet; a drill 6 feet.

A new drill has lately been introduced in the East which drills wheat in rows 18 inches apart. It admits of hoeing or cultivation between the rows by horse-power, by taking the drills from the same machine and attaching cultivators.

He mentioned a wheat plant in his grounds in Delaware that had 104 heads from one seed or grain of wheat; but while some were ripe, other heads were green. This was winter wheat.

He favors soaking the seed in brine or vitriol. Soaking in brine will destroy smut. There are, however, mechanical difficulties in soaking seed. There is danger in drying it, and if it is not thoroughly dry the seed will adhere in sowing.

The time of sowing is before the frost is out of the ground emphatically—as soon as there is enough earth to cover the seed.

The interest of farmers and millers is not identical in respect to harvesting. The farmer wants the most pounds.

Dr. Kedzie, of Michigan University, is conducting experiments in this matter. In a small field harvest when the grain is brown, and when it is so hard you cannot crush it between your thumb and finger. Where a field is very large the harvesting would need to be commenced earlier. It is for the interest of the farmers to thrash without stacking and get the grain to market. When in the elevator it can be kept from heating. If, however, the farmer must put his wheat in the bin, then by all means he should stack and let the wheat go through the sweating process. Professor Porter sees out this way but very few stacks that are properly made. One should get a Scotchman or some one who has had experience in the moist climate of Great Britain, where they thoroughly understand the practice of building stacks, to show how they are to be made. A rule in making stacks is to keep the center of the stack full. Begin in the center. Never tramp the outside, but let that settle of its natural weight. Of course the butt ends of the sheaf should be outwards and the grain ends inwards.

It is the advice of one of the most successful raisers of grain to always put it in the market as soon as it is ready, and not store it for a rise in the price; considering the risks of weather, vermin, insurance, and also the uncertainties of the market, it is probably best to sell as soon as may be.

Statement of Mr. A. W. Tiffany, Norwood, Carver County.

[Carver County lies on the north bank of the Minnesota River, and immediately west of Hennepin County. Its surface is rolling, and before being settled was mostly covered by the "Big Woods." Its soil is a clay loam and very well adapted for wheat. It is settled mainly by Germans and Scandinavians. Mr. A. W. Tiffany, whose farm is at Norwood, on the western prairie and part of the county, has grown wheat there during the last twenty years. He says:]

When I began the yield was 25 bushels per acre. A noticeable decrease commenced about six years ago and has continued since, with the exception of 1877. The average yield now is not over 12 bushels per acre. The "Scotch Fife" is the variety raised. I attribute the decline partly to the exhaustion of the lime in the soil and partly to the weather, which of late years has been unfavorable. I have practiced a rotation of crops all the time, my rotation being after wheat oats, then corn, then wheat. Have also seeded down some grass. I see that we have got to raise stock and corn.

Statement of Mr. T. C. Porter, Clearwater, Wright County.

I have grown wheat in Sherburne and Wright Counties, the past thirty years, but chiefly in Wright County, and have generally got a good crop on new land the past three or four years. The yield has gone down from 25 bushels per acre to, at times, 8 or 9 bushels. I attribute the decline in the yield more to drought than to heat, in our section of country. A majority of farmers there practice a rotation of crops, and have done so the last six or seven years. Hence the average yield in Wright County has now been right along about 12 to 14 bushels of wheat per acre. The usual rotation is corn, then wheat. They are getting into grass and clover. There is considerable timothy, but not much clover yet. I have never gone into clover myself. My rotation is wheat, oats, and corn. I manure a good deal, hauling most of the manure from the village half a mile distant. I have been farming on that farm twenty-five years, and get about as good crops as when I began. Had about 15 bushels per acre of hard wheat this year. Have not used salt on the land, but have been thinking of doing so.

I raise a little "Lost Nation" for my own use. I get better flour from that at our home mill for our home use than I do from the hard wheat. It is ground separately. The yield of the "Lost Nation" was about the same as that of hard wheat this year. Last year it yielded three bushels per acre better than "Scotch Fife."

Our farmers now fatten a good deal of stock. Over 800 head of beef cattle were shipped last spring from within a circuit of 8 miles including Clearwater. They were sent to Winnipeg. I think millers pay enough more for hard than soft wheat to make it an object to raise the "Scotch Fife."

Statement of Mr. O. M. Linnell, Grove City, Meeker County.

[Mr. Linnell, a native of Sweden, has raised wheat more or less for twenty-five years in Minnesota, and for the past six years in Meeker County, which is considered a good farming county. He states:]

I have observed a decline in the yield of wheat; especially the last six or seven years there has been very much change. It has occurred as much on land that was formerly covered with timber as on prairie soil. I attribute the decline almost wholly to the climate, because new land that has never been worked does not yield as it did in former years. Of course where land is worn year after year with wheat it cannot be expected to yield as well as if a rotation of crops had been practiced. My rotation has been wheat, oats, corn, and then wheat. The proper way is to seed to pasture, but we have not got to that in Meeker County. My yield last year was 22 bushels per acre of hard ("Scotch Fife") wheat. This year on 200 acres I raised 2,002 bushels of the same sort, averaging 13 bushels to the acre. I do not think the average yield in Meeker County would go over 10 to 12 bushels per acre. On some farms it would be 5 bushels, on others 19 bushels per acre. Those who raise "Lost Nation" average 2 to 5 bushels more per acre than those who raise hard wheat, and get the same price for it; consequently there is a temptation for others to raise "Lost Nation." I don't think the millers give enough more for hard wheat to make it an object to raise it in preference to raising "Lost Nation." It costs us 12 cents a bushel to get our wheat from Grove City to Minneapolis, a distance of 75 miles. The charge for elevator storage is 3 cents a bushel, and the freight by rail is 9 cents a bushel. It is the same from Litchfield.

Many of the farms in Meeker County have been continuously cropped with wheat for the past twenty years. To restore the yield I would decidedly recommend a rotation of crops. Clover has been tried around Litchfield with middling success, but not where I am. I attach great importance to plowing early in the autumn. In many cases it is worth 5 bushels an acre more. By plowing early all the foul stuff will then grow and the frost will kill it. The ground will also be more solid and suitable for wheat.

Statement of Mr. T. H. Caine, Spencer Brook, Isanti County.

Isanti County is situated on a line with the Sauk Rapids of the Mississippi and the Falls of Saint Croix, and midway between them Rum River runs through it, and its northern and eastern sides are covered with hard-wood timber. The rest of the county has a sandy-loam soil, a part of it being light. (The county is settled principally by Swedes.) The average yield of wheat in the county is 12 bushels per acre. The kind raised is "White Fife," hard. There has been, I think, no perceptible falling off in the yield, as the farmers generally have raised considerable corn and stock, and occasionally varied their crops. The soil appears to stand the dry weather very well, and two or three good crops of corn can be raised successively without manure.

Statement of Mr. John Cooper, Saint Cloud, Stearns County.

[Mr. Copocr has had twenty years' experience in wheat-growing, fifteen of which have been in Minnesota. His farm is situated on Pearl Lake, 12 miles southwest of Saint Cloud, and consists of timber, prairie, and brush land.]

My yield of hard wheat last year was 25 bushels per acre. This year it was 14 bushels; the decreased average arising from 10 acres being covered with water, and not producing anything. There appears to have been a decline in the yield of wheat in the southern part of the State, which is considered owing to the weather; but up in my part of the State I think that on farms that have been systematically cultivated wheat yields as well as it formerly did. Our good farmers in Stearns County last year got an average yield of 20 bushels per acre.

This year the same farmers raise 13 or 14 bushels per acre. The farm of Messrs. Coates & Freeman, on the east side of the Mississippi River, about half a mile from the river and opposite Lower Saint Cloud, near the south line of Benton County, this year produced 25 bushels of "Scotch Fife" per acre on new land, and 17 or 18 bushels per acre on old land.

Where there has been careless farming, or where land has been run to wheat continuously for many years, there is of course a decrease in the yield. Among some farmers there is a slackness in regard to the time when certain work should be done. Then, again, good land has been so cheap that farmers have felt that they would not suffer much damage by letting their land get worn out.

This has been one cause of continuous wheat-growing on the same land. They have not considered the land worth enough to keep up its quality by proper rotation and cultivation. To maintain good crops, good farming must be practiced, and a systematic rotation, say of wheat, oats, and corn, and where there is not a sufficiency of natural meadows it would be desirable to have a part of the farm in timothy and clover.

When I took my present farm there were 16 acres which had been run to wheat twelve to fifteen years; so that it producedscarcely anything. In plowing it, I found a crust 4 inches deep had formed on the clay in consequence of the shallow plowing which for years had been practiced. To get below this and break it up, I had to plow a foot deep. My neighbors said I would get no crop. I sowed the field with oats, and never saw such a crop. Some of the oats were 5 feet high. A portion were flattened by the wind so they could not be harvested, and yet I got 78 bushels per acre. I raised wheat on the same land the next year (1879) and got 20 bushels per acre; also, the same in 1880. I had wheat on it this year, and the average was 14 bushels per acre.

The standard variety of wheat with us is the "Scotch Fife," but the yield has lessened some in consequence of continuing it without a change. It is well every few years to change the seed from one soil to another; to use on sandy soil that which has been grown on clay soil, and the reverse. A sort called the "White Fife," which is a Russian variety, but not as hard as "Scotch Fife," yet harder than the "Lost Nation," has been in use in Stearns County five years, and is now grown there quite generally. The farmers get as much for it as for any other sort. One of our millers, Mr. Arnold, says he will pay as much for it as for any other sort.

In regard to the method of farming to be recommended, I would say, in opening a new farm break the land not later than the 20th of July, and perferably in the month of June, to a depth of 3 or 4 inches. If the soil is sandy let the plow go to the depth of 4 inches. Back-set the furrows in the autumn, plowing an inch deeper than the breaking. There is no part of farming which pays better than back-setting. Grubland had better be broken in September. As to raising a crop the first year of breaking sod, corn does well enough; but to get a crop of corn one has to break a little earlier than is good to do. So some take a crop of flax on new breaking,but the general opinion of farmers is that it is very exhausting to the soil. The autumn plowing on land which has been under cultivation can be done with the 16-inch sulky-plow, using three horses. I regard it as exceedingly essential that this plowing be done as early as possible after harvest. Though it is hard work to plow when the ground is dry, still I would not wait for rain. The benefits of early fall plowing are, that the foul stuff, barn-grass and the like, which is then green, gets killed, and that which is ripe and gone to seed will grow up so the frost will kill it the same season. Ordinarily I would plow 6 or 7 inches deep, and once in about three years a foot deep. Deep plowing permits the moisture to come up, and thus proves beneficial in a dry season. It is also an advantage for corn.

Fanning mills with separator attachments are sufficient for taking the cockle out of wheat and getting the seed clean enough for sowing. Spring wheat should be sown as early as possible—just as soon as the frost is out of the ground enough to admit of working. I would sow early, even if the ground is wet. I have many times put in wheat when the ground was like mud.

The great danger to wheat is the hot sun at the time when it is filling in the milk, and the sooner it is got into the ground the better its chance to escape the hot weather, which is generally the most dangerous in July. It is usual to sow in Stearns County from the first to the last of April. The last three or four years we have sown the first part of April—ordinarily from the 1st to the 10th.

As to the preparation of the soil for sowing: Generally, if the ground is not too rough, it will do as well to sow without first harrowing. One has to be governed by the condition of things. I sow with the broadcaster. It is in general use in our vicinity. The hoes attached to the broadcaster follow the seed-spouts and cover the seed thoroughly. There is no need of harrowing after the broadcaster covers the seed, though it sometimes may be desirable to harrow to smooth the ground.

It is a question as to rolling. I think it is better to roll, unless the ground be wet; also, to roll when the wheat is an inch or two high. We have high winds in May, but the soil does not sift where the rolling is done after the wheat is up. Deep plowing makes a loose and moist soil underneath, and rolling a compact soil at the top. I have not tried salt on wheat land.

We judge of the fitness of wheat to harvest by its color, and usually commence in Stearns County the latter part of July. It is best to cut when the wheat is in the dough. If a farmer has considerable to cut he cannot wait till it is all ripe. We generally commence early and cut with the twine binder. Two men follow to put the sheaves in shocks. The best way to shock wheat, I think, is to put a dozen sheaves in a shock, two by two, capping the row with two sheaves, tops down. Many farmers neglect stacking too long. We most always have rains—the fall rains—after harvest, which catch some farmers before they have stacked. Wheat that is tolerably ripe and free from green weeds will, if the weather is favorable, cure in a day or two, and can then be stacked. I would advise thrashing from the shock where one is close to the railroad and can ship readily. In such case it is as easy to ship as to store in the granary.

Generally there is a demand for new wheat. At that stage it thrashes easily enough. Where it is not thrashed from the shock with a view to shipment it should be stacked and allowed to go through the sweat. Wheat is always better for going through the sweat. In that process the berries are fed from the straw and become better filled out and plumper, and have a brighter color. Wheat then looks better than it does when thrashed from the shock. If reasonably ripe, and the weather is favorable, it will get through the sweat in from ten to fifteen days. In three days after it is stacked the straw will feel quite damp as you put your hand into the stack. The sweating commences almost immediately; it would not progress so well of course in wet weather, as the atmosphere would not then take up the moisture. The stacking of wheat is a trade that one must learn. In every farming community there are usually some good stackers whose assistance can be had. Wheat does not cure so rapidly in big stacks as in those of medium size; hence the latter are preferable. They should be well made. In locating the stacks one should be governed by what he intends to do with the straw. I would assume that the straw will be used for fodder. In any event I would put the stacks in settings of fours, two on one side and two on another side, so as to pitch from the four stacks to the threshing machine without moving it. I don't like the idea of burning straw. Good, bright wheat straw can be fed with a little bran, say three or four quarts of bran a day to an animal. You can thus winter stock on straw and bran cheaper and better than you can with hay at $5 a ton. Bran runs generally from $4.50 to $10 a ton. It is now worth at Saint Cloud $10 a ton. At Minneapolis it is worth $11 a ton. It is high this season on account of the injury done to hay by excessive rains, good natural meadow hay being now worth $10 to $12 a ton, whereas, in ordinary seasons, the same sort of hay is worth $5 a ton. Assuming that the straw is to be consumed as feed, it should be put into neat sacks at the time of thrashing, and as it comes from the machine. One or two extra men would thus stack it with little trouble and waste.

Steam thrashers are now the best. Of the machines now in use, two-thirds are steamers with spark protection. This year we paid 5 cents a bushel for thrashing wheat, and 3 cents a bushels for thrashing oats.

Wheat should be stored in a ventilated granary built firmly on rock or block foundation. A nice way to construct a granary to keep out the vermin, is to put it on blocks with a tin pan the shape of a milk-pan resting inverted on each post, the sills resting on the pans. Bring the floor of the granary about up to the height of a wagon box, so that it will be easy work in loading and unloading. We will say that on a farm of 160 acres the average number of acres in cultivation will be from 80 to 100, of which usually one half, or say 50 acres, will be in wheat. A granary 20 by 30 feet would give room for the wheat and oats on such a farm, and it should not cost over $200 complete, tight and well-ventilated.

In hauling to market 50 bushels will make a load for a two-horse wagon. A wheat sack will contain 2 bushels; or, as full as it can hold, two bushels and a peck. The sacks are made of cotton. They are manufactured at Saint Louis, at different places East, and in Minneapolis. They cost from $18 to $22 a bale of 100 sacks according to quality, and will last ten years if properly cared for.

I usually sow oats after wheat; many farmers sow them before wheat. They ripen and can be cut before wheat. I don't think they do as well when exposed to cold, wet weather, and it is for that reason that I do not sow them until after my wheat is sown. I use the white variety, which is commonly grown, and sow 3 to 3½ bushels per acre, putting in the seed with the broadcaster. I would prepare the soil the same for oats as for wheat. Also, roll the ground after the oats are up, just as in the case of wheat. They usually ripen a week earlier than wheat. They should be harvested with the self-binder, stacked and handled just the same as wheat. They go through the sweating in stack the same as wheat.

Oats are stacked with some reference to consumption of straw for fodder. As the straw is much better for this purpose than is wheat straw, I would therefore stack the oats near the barn. Stack the oat straw and feed it with bran, either whole or cut up. Oats generally yield from 40 to 60 bushels to the acre. I think oats, like other seed, should be changed every few years from one kind of soil to another. Would hardly venture to manure the ground for oats; would prefer to take my chances by manuring corn. In a dry season manure is apt to heat. Though an ordinary frost will not damage oats, a severe one will.

Oats in this respect stand between corn and wheat. I would put oats after wheat, after oats corn, and then wheat again.

A field intended to be planted with corn can be plowed in the spring instead of the fall. The manure can then be hauled and spread before plowing. It is afterwards useful to harrow, to smooth the surface. Then mark the ground with four sled-runners fastened together 4 feet apart. Then mark crosswise and put in the seed with a corn-planter. When the corn is up begin to cultivate it.

On a 40-acre field you can keep a man at work cultivating from the time it is up till it is too high to work. The sulky cultivator, such as is now used, having four shovels, two for each row, will cultivate two rows at a time. It is as effective as a single-horse cultivator, and one can do double the work with it.

A good average crop of corn is 40 to 60 bushels per acre. We use the "Early Dent," which matures in ninety days. We gather the seed corn before harvesting, and hang it up where an early frost could not injure the germ.

On a farm of 160 acres, and 100 under cultivation, the work can be done by the farmer himself, with an assistant during six months, with wages at $18 to $20 per month. Farm hands have now no ground of complaint against their employers. As a rule, men who work out on a farm at wages do not lay up anything, but spend all they earn. Foreigners often get dissatisfied with their pay after being in this country a couple of years. Twenty-five dollars a month ought to get a thoroughly trusty man.

On a farm the size just above mentioned the following stock and implements would be required for profitable cultivation:

Three horses, at $150 each	$450	One wagon	$75
One pair of oxen	100	One sled	35
A sulky three-horse plow	50	One broadcaster	55
Attachments to same for breaking	15	One corn-planter	5
A two-horse cultivator	30	Spade, shovels, hoes, hay-forks, rack, &c	60
One three-horse reaper, self-binder	275		
One harrow, two horses	15	Total	$1,165

Average milch cows now cost from $25 to $30 each.

Statement of Mr. Ole Peterson, Gilchrist, Pope County, Minnesota.

[Mr. Peterson, a native of Norway, has been actively engaged in farming and wheat culture in this country the past sixteen years. He says:]

In regard to the successful production of wheat, I think the farmers will have to cultivate the soil better and raise more corn. I find if I put corn on the land, cultivate it, and keep all the weeds out, I will the next year have a good crop of wheat, and if that does not keep up the land, I would advise seeding it down to clover one or two years, and plowing the clover under the second year. The land will then be just as good as new, and will produce 20 bushels of wheat to the acre. The greatest fault with farming in Minnesota is that the farmers always sow wheat. I would advise to sow wheat two or three years, then oats, then wheat and clover, and the next year plow the clover under. If this is kept up the land will continue to produce wheat.

Statement of Mr. C. B. Buckman, of Buckman, Morrison County, Minnesota.

I have been engaged in wheat-growing the past eight or nine years. Have 1,100 acres of bush and prairie land under cultivation, the soil of which is a deep, black loam, with clay subsoil.

Have always grown "Scotch Fife," and the yield has never been less that 20 bushels per acre till this year, when it was about 15 or 16 bushels. I have practiced some rotation, because I considered it essential to do so to keep up the yield. The cheapest and most effective rotation is to seed the land with grass and clover. Farmers are generally getting to feel that it is necessary to adopt a rotation of crops.

The "Lost Nation" has been tried by some in my vicinity, but without success. Early autumn plowing is unquestionably the best for wheat. I have never seen good wheat on spring plowing. I have changed my seed wheat from different soils every year or two.

The small variety of corn does well in our county. Flax is not raised there.

There is no difficulty now in getting good labor. A part of it is transient. Wages are from $18 to $26 a month. The workmen rise at five in the morning, and generally labor eleven or twelve hours a day. There is no complaint as to the non-payment of wages.

Statement of Mr. D. Burbank, Pelican Lake, October 12, 1881.

I have been farming but seven or eight years in the Northwest, during the first four of which my crops were very much devastated by locusts. My land is rolling prairie and bush, and the soil sandy. If I have new breaking to do, I commence just as soon as possible after wheat and oats have been put in, so as to plant corn, potatoes, beans, and ruta-bagas in the sod. Old ground I would always plow in the fall for wheat or oats. I harvest the crops as soon as the grain begins to harden, and stack immediately, then if I have not put up enough before harvest, I finish haying, and commence plowing for the next year's crop, and get through, if possible, before the end of September. I thrash at any convenient time after the grain has gone through the sweat. For wheat I plow deep, from 6 to 8 inches. The seed should be sown in the spring just as soon as the ground can be prepared, but no sooner. The ground should be harrowed at least twice before sowing the seed, and as many times afterwards as is necessary to pulverize the soil.

If the ground is cloddy I use a roller to crush the lumps, at any time from before the seed is sown till the grain is several inches high. I have harrowed grain after it was several inches high with good effect. I have ordered for next spring's work two "Thomas smoothing harrows" for myself and son-in-law. I intend to use mine in cultivating growing crops of wheat, oats, corn, and potatoes. I have thus far raised the "Fife" wheat, but shall raise any kind that promises to be the most remunerative.

If the manufacturers of flour want the farmers to raise any particular variety of wheat they must offer such a price for it as will make it as profitable for the farmers to raise that variety as any other.

I use a broadcast seeder to sow my grain, using five pecks to the acre, of wheat, and ten pecks of oats. I think the drill is a better machine to sow grain than the broadcast seeder. I intend to get one as soon as I am able, and expect then to use less seed to the acre. I used a little salt on some small patches of wheat this year, but did not discover any effect from it. Shall try it again. I never burn my straw, but have found it difficult to use it all up. I make straw sheds and get stock to eat as much as I can, and trample the rest under foot so as to make it rot sufficiently to haul out for mulching and top dressing.

I have a small flock of sheep which I am increasing as fast as I can (using a thoroughbred Cotswold buck and native ewes). I intend to increase the number of cattle and hogs on the place as fast as I can fence off suitable lots and pastures for them. The breed of hogs I have is a cross of the Berkshire and Poland-China. I would have the pigs come about the 1st of April, feed them all they can eat, and kill them before Christmas. I shall have a clover pasture for them to run on if I can succeed in making the clover grow. As yet I have had rather indifferent success, but enough to stimulate farther effort. I have not got any rotation of crops fairly established yet, except that I seeded two or three years ago some of my oldest ground with timothy and clover. The grass has done as well as I could have expected. It should have had a dressing of stable manure or some green crop plowed under. I shall pursue one of two courses next spring with this piece of grass land: I shall either top dress it with well-rotted stable manure, of which I now have a considerable quantity, harrow it thoroughly with the Thomas harrow and reseed it, or I shall plow it and plant with corn, potatoes, and turnips, and seed down another piece of land.

Farmers have just begun to raise timothy and clover in this vicinity; a few tried flax for the first time this summer. I do not think many of them will try it again soon, though it grows without much trouble, but they do not understand handling it.

Several varieties of corn are raised here successfully. The kind which I have raised for several years, and like very well, is the "White Flint." I obtained the seed from Red Lake Reservation. It was a mixture of blue and white. I have improved it by selecting the white to plant till the blue has entirely disappeared. I have never measured the yield, but think I can easily raise 40 to 50 bushels of shelled corn to the acre. Think I should have had as much this year but for the injury done by crows and gophers in pulling up the young corn. I have heard that this can be prevented by soaking the seed in coal-tar. I shall try it next season.

My method of cultivation is what is called level culture. I plant the seed on level ground, about 3½ feet apart each way, and harrow once or twice before the corn is up, and several times afterwards. Then use a horse-hoe, or double-shovel plow. I thin to three stalks in a hill and pull off the suckers once or twice.

On account of the scarcity of labor I think the farmers about here will have to raise more stock. Sheep are very healthy, easily and cheaply kept, and this country appears to me peculiarly well adapted to raising them.

A farmer owning 160 acres of land might keep 200 sheep, 5 or 6 good cows, and fatten every fall 10 hogs, and do all the work with the help of a hired man for six or seven months. If he has large boys he would not need to hire; 50 or 60 acres would be enough to keep under cultivation. The rest I would keep in woodland and pasture.

Farmers here do not appreciate the value of grass and hay. I have this year raised about 250 bushels of wheat on 15 acres of land, and have put into my barn 30 tons of hay. Though wheat brings a good price, I consider the hay the most valuable crop.

I cut the prairie hay, rake it and haul in the same day it is cut, and it keeps sweet all winter. With the mower and rake and help of one man I can get in 2 to 4 tons a day. For teams a man needs three horses and a yoke of oxen.

I know of nothing special to complain of on the part of farmers or hired men, except that wages are higher than farmers can afford to pay. A laboring man can clothe himself decently and comfortably with $50 per annum. Fourth of July is the only holiday observed here between the 1st of April and 1st of November. During this season hands get $20 per month—$12 to $15 the rest of the year.

Quite a number of Scandinavian and German women card and spin their own wool, but not many Americans. Wool-carding by water-power has been established at Fergus Falls, and I presume we shall all find it cheaper to get our wool manufactured there.

Statement of Mr. C. B. Kitteredge, of Glyndon, Clay County.

I have raised wheat in Clay County four years. The soil of my farm is sandy loam, 12 to 15 inches deep, with clay subsoil. I have turned my attention more to keeping cows and small farming than to wheat growing. This year I had no wheat, only oats and barley—about 85 acres. Last year a part of my 40 acres of wheat was very poor on account of mixed seed; the balance yielded 18 bushels.

From observation I should say that the wheat crop is as large on old fields this year as in previous years. Some of our land is better for wheat the second and third year than the first. In some cases weeds, wild buckwheat, &c., have diminished the crop.

As to the best system for a profitable cultivation of wheat in this locality, I would say the land should be well plowed in the fall, a crop sowed early in the spring, harvested as soon as ready, and allowed to stand in shocks as short a time as possible before stacking. I would have no objection to growing wheat several years in succession upon the same land, but think the sooner we introduce stock-raising in connection with it the more profitable will be wheat-raising to the average farmer.

Statement of Mr. Alfred Diamond, Tamarac, Marshall County, Minnesota.

[Mr. Diamond has a very well-cultivated homestead farm of 160 acres, near Stephen raiload station, one corner of which is crossed by the prettily-timbered Tamarac River. The soil is a rich black loam, with clay subsoil. He has started a hedge of willows around his farm, and has several nurseries of young forest trees, which, at the time of my visit, August 5, were growing thriftily and entirely free from weeds. His field of wheat was then green, though an adjoining field on the Stephens farm was cut and in shock. Both fields seem to promise a yield of fully 25 bushels to the acre. Mr. Diamond's wheat-field was newly broken last summer.

He informed me that the seed ("Scotch Fife") had been picked over by hand by himself and wife, and that he sowed only a bushel and a peck per acre. When it came up it looked, he said, as if not enough seed had been sown, and people remarked to him, "You will not have anything of a crop, because it is so thin." He has been engaged in wheat-growing in Minnesota about fifteen years, and in Marshall County three years. His statement is as follows :]

I have noticed that when large tracts of land are cultivated in wheat there is a decrease in the yield, which, I think, is owing in a great measure to want of proper cultivation, allowing the land to get weedy; also to the increase of insects that are injurious to the crops, which latter, I think, is mainly due to the decrease of forest birds.

I think that mixed farming, with stock raising, is the best system to maintain a profitable cultivation of wheat. If I were to only raise wheat on a certain piece of land, I would summer-fallow it every fourth year.

Although wheat-raising this year has been very profitable in this section, I have not changed my views in regard to raising wheat alone.

Statement of Mr. Andrew McHench, Fargo, Cass County, Dakota Territory.

I have raised wheat in Cass County, Dakota, eight years, and have seen it grow here for nine years. The soil is clay loam, with scarcely any sand, but considerable lime. In this time the decrease in yield has been slight, and mostly caused by foul seed, such as wild buckwheat. The sod here is very rooty and makes a good fertilizer.

To maintain the best yield, and most profitable cultivation of wheat, I would say, plow shallow at first, about 2½ inches, and each succeeding year from half to one inch deeper, till you reach 5 or 6 inches. Wheat has grown in the valley for fifteen years, rotating with oats. Oats will improve the soil for wheat.

Early fall-plowing I consider the best to maintain the best yield. Seeding with timothy will kill the weeds and renew the soil. Clover will winter-kill too much.

Wheat should be sowed as early in the spring as it can be put in. Wheat will grow too rank after potatoes, and to renew land by hoed crops could not be carried on to much extent.

○